How many vPvM/PMT substances have been registered under REACH? - vPvM/PMT screening by using the Danish QSAR database

Holmberg, R.; Wedebye, Eva Bay; Nikolov, Nikolai Georgiev; Tyle, K.

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# ABSTRACT BOOK
## SETAC Europe 28th Annual Meeting

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This book compiles the abstracts from the platform and poster session presentations at the 28th Annual Meeting of the Society of Environmental Toxicology and Chemistry - Europe (SETAC Europe), conducted at the Rome Convention Centre La Nuvola, Rome, Italy, from 13 – 17 May 2018.

The abstracts are reproduced as submitted by the author and accepted by the Scientific Committee. They appear in order of abstract code and alphabetical order per presentation type. The poster spotlight abstracts are included in the list of poster abstracts. The presenting author of each abstract is underlined.

## SETAC Europe Office
Avenue de la Toison d’Or 67
B-1060 Brussels
Belgium
T +32 2 772 72 81
F +32 2 770 53 86
setaceu@setac.org
setac.org

## SOCIETY OF ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY
In the 1970s, no forum existed for interdisciplinary communication among environmental scientists, biologists, chemists, toxicologists, managers, engineers or others interested in environmental issues. The Society of Environmental Toxicology and Chemistry (SETAC) was founded in North America in 1979 to fill the void, and quickly saw dynamic growth in the Society's membership, meeting attendance and publications.

A unique strength of SETAC is its commitment to balance the scientific interests of government, academia and business. The Society by-laws mandate equal representation from these three sectors for officers of the World Council and Geographic Unit Boards of Directors and Councils, and in the composition of committees and other society activities. The proportion of members from each of the three sectors has remained nearly equal over the years.

The Society is concerned about global environmental issues. Its members are committed to Environmental Quality Through Science®, to timely and effective communication of
research, and to interactions among professionals so that enhanced knowledge and increased personal exchanges occur. Therefore, SETAC publishes two globally esteemed scientific journals and convenes annual meetings around the world, showcasing cutting-edge science in poster and platform presentations. Because of its multidisciplinary approach, the scope of the science of SETAC is broader in concept and application than that of many other societies.

SETAC’s growth is reflected in the founding of geographic units around the world. SETAC Europe was established in 1989 as an independent organisation, followed by SETAC Asia-Pacific in 1997 and SETAC Latin America in 1999. In 2002, the four existing organisations joined together under the governance of the SETAC World Council. SETAC Africa is the most recent geographic unit, which was adopted in 2012. As evidence of international acceptance of the SETAC model and of the great interest at the local level, regional chapters and branches have emerged in a number of countries.

SETAC publishes two journals: *Environmental Toxicology and Chemistry* (ET&C) and *Integrated Environmental Assessment and Management* (IEAM). Environmental Toxicology and Chemistry is dedicated to furthering scientific knowledge and disseminating information on environmental toxicology and chemistry, including the application of these sciences to risk assessment. Integrated Environmental Assessment and Management focuses on the application of science in environmental decision-making, regulation, and management, including aspects of policy and law, and the development of scientifically sound approaches to environmental problem solving. Together, these journals provide a forum for professionals in academia, business, government, and other segments of society involved in the use, protection, and management of the environment for the enhancement of ecological health and human welfare.

SETAC books provide timely in-depth reviews and critical appraisals on scientific subjects relevant to understanding a wide range of contemporary topics pertaining to the environment. These include any aspect of environmental chemistry, toxicology, risk assessment, risk management, or environmental policy.

SETAC has two administrative offices, in Pensacola, Florida, USA, established in 1992, and in Brussels, Belgium, established in 1993.
Keynote abstracts

Keynote Sunday
Responsible Research and Innovation (RRI) - a Path towards Sustainability? Bernhard Url, University of Bergen, Centre for the Study of the Sciences and the Humanities, Norway

Responsible Research and Innovation (RRI) is a cross-cutting principle of EU’s research funding programme “Horizon 2020”. Indeed, in Rome 2014, scientists and policy-makers jointly produced the “Rome Declaration on RRI in Europe”; that states that “excellence today is about more than ground-breaking discoveries – it includes openness, responsibility and the co-production of knowledge”. The principle of RRI acknowledges that civil society is entitled to “speak back” to science and help shape the knowledge and technology of tomorrow in an ethically acceptable and sustainable direction.

What does RRI entail in practice, for researchers, innovators and policy-makers? How could RRI principles, indicators and practices help to pick up more early warnings to avoid costly late lessons from unfortunate impacts of science and technology? The lecture will present the conceptual basis of EU’s RRI policy. Specifically, a full appreciation of RRI depends on a theoretical understanding not only of risk, but also of decision-making under uncertainty, ignorance and indeterminacy.

Keynote Monday
Food Safety in a Complex Changing World Eugenia Dogliotti, Istituto Superiore di Sanità, Department of Environment and Health, Italy

EFSA provides independent scientific advice on all matters related with food and feed with a direct or indirect impact on human, plant and animal health. Effects in the environment are also considered as they may pose an indirect risk to food and feed. EFSA takes into account environmental risk assessment in its assessments of the application of plant protection products, the deliberate release into the environment of GMOs and the use of certain substances in food and feed (e.g. feed additives). EFSA also assesses the environmental risks related to the entry and spread of invasive alien species harmful to plant health.

EFSA is looking into the future, keeping up with a rapidly evolving and globalised world, characterised by dramatic environmental and other global changes (e.g. economic, political social, and technological) and an exponential growth and availability of data. These set new opportunities and challenges to the assessment of risks to both the environment and food safety and can drive their (re)emergence.

In this context, EFSA is reviewing the methodologies for risk assessment and for the identification of emerging risks within its remit.

Predictive modelling tools based on holistic approaches for environmental risk assessment in realistic landscapes and under different scenarios of multiple stressors are being developed. Approaches considering the complex interactions and dynamics between the different food system actors, their behaviour and external drivers are proposed as tools useful for long term anticipation of emerging risks. Expert knowledge elicitation, horizon scanning, and crowdsourcing are being explored as tools to broaden participation, strengthen engagement of all relevant stakeholders and manage interconnectivity, in application of principles of resilience thinking.

Environmental quality and food safety are strongly intertwined. They need to be considered together when aiming toward the achievement of sustainable development goals. Consistent approaches for scientific assessment and data management need to be developed, integrating also societal, technological and economic drivers to effectively cope with the dramatic global changes and the data revolution we are observing.

Keynote Tuesday
Innovative Research Issues in Environmental Mutagenesis Roger Strand, AstraZeneca Global Safety, Health and Environment, UK

During the 1920s, mutation research was put on a firm basis by H. J. Muller, who developed the concept of “mutation rate” and devised quantitative techniques for its measurement. These techniques allowed the discovery of the mutagenic action of ionizing radiation and paved the way for the pioneering work of C. Auerbach on chemical testing, starting with mustard gas. Since that time the recognition of the multitude of possible sources of mutagenic insults promoted the development of the science of environmental mutagenesis. Today the mechanisms by which chemicals induce mutation and the role of genetic susceptibility in the response to environmental mutagens have been largely explored. Moreover, a battery of test methods is available for regulatory purposes. What are the current challenges in environmental mutagenesis? New techniques for mutation research have been developed. The “omics” techniques such as whole genome sequencing, epigenetic profiling, transcriptomics, proteomics and metabolomics have provided a snapshot on the effects of genetic polymorphisms, gene regulation, protein synthesis and stability, metabolic pathways in the control of cell function. This presentation will describe: 1) the successful identification of the mutagenic environmental agents underlying certain types of cancer by using whole genome sequencing; (ii) the evidence that epigenetic alterations mediate toxicity from environmental chemicals and, (iii) the use of the exposome approach, that comprises all environmental exposures that a person experiences from conception throughout the life course, to unravel complex gene environment interactions that affect disease risk.

Keynote Wednesday
The Environmental Dimension of Antimicrobial Resistance: Assessing and Managing the Risks of Anti-infectives Jason Snape, AstraZeneca Global Safety, Health and Environment, UK

Antibiotics are vital in the treatment of infectious disease in both livestock and human health and they are entering the environment continuously. In freshwaters antibiotics can reach concentrations up to mg/L, but more commonly they occur in the low to sub μg/L range. They selectively target bacteria and thus there is an increased likelihood for impacts on environmental bacteria populations at levels well below that for effects on aquatic vertebrates. However, current environmental risk assessment (ERA) frameworks of antibiotics, as required by the European Medicines Agency guidelines 2006, adopts the use of one species of cyano bacteria only to represent all bacterial diversity. The activated sludge respiration inhibition test (ASRIT), used to identify risk to microorganisms in sewage treatment plants has also been proven to be insensitive for antibiotics. Thus, there is concern that the ERA for antibiotics does not fully consider their potential impacts on microbial community structure, function and resilience. In addition to the risk posed to ecosystem function there is a global concern on antimicrobial resistance (AMR) development and the associated risk to human health. It has been proposed that the risk of AMR development in the natural environmental should be included in ERA but there is currently no standard experimental methodology or framework to address this. Recently, a theoretical approach that makes use of minimum inhibitory concentrations (MIC) of clinically relevant bacteria (CRB; using the European Committee on Antimicrobial Susceptibility Testing (EUCAST) database) has been proposed to predict no effect concentrations (PNEC) for AMR development (PNECR). To help define science-based protection goals for antibiotics for use in a prospective ERA frameworks and to define safe discharge concentrations for antibiotic production and patient use this presentation will review the publicly available aquatic ecotoxicity data for antibiotics to assess the following: 1) the relative sensitivity of commonly used taxa in aquatic ecotoxicity to antibiotics; 2) the value of extending the toxicity testing to a more diverse range of bacteria species and: 3) how a PNECR relates to the PNEC derived for surface waters (PNECSW) using standard ecotoxicity testing. This presentation will describe (i) the output of this analysis of protection goal data and (ii) how the wider pharmaceutical industry are addressing concerns with antibiotic residues associated with manufacturing operations.
Platform Abstracts

Modelling and monitoring of pesticides fate and exposure in a regulatory context (I)

1 The SETAC DRAW workshops - aims, approaches and progress to date

N. Mackay, FMC Corporation / Environmental Modelling; A. Aix, Dow AgroSciences / Risk Management; G. Azimonti, ICPS; A. Chapple, Bayer Crop Science AG; P. Miller, Silsoe Spray Applications Unit Ltd; K.M. Niemstedt, European Commission - DG SANCO / PPR; C. Piciki, Federal Environment Agency; T. Wolf, AgrarNiemand Ltd. In order to develop a more complete understanding of spray drift to improve the regulatory basis for representation in risk assessments, a set of SETAC workshops known as DRAW (Drift Risk Assessment Workshops) are underway to facilitate a range of efforts: Assemble and interpret a database of the spray drift trials for boom sprayers; Develop a programme of trials to more fully characterise drift influences; Use this information to develop proposals for standardized protocols for drift characterization in the field Develop an enhance role for mathematical modelling as a higher tier risk assessment option; and Expand and reinforce the toolbox of regulatory risk mitigation measures. This presentation will focus upon: Database development and study design The workshop database currently comprises 56,001 data points from a wide range of studies, providing a rich, complex basis for supporting a range of different research efforts. Because of the variation in study designs and the consequent difficulties with interpretation there is a clear motivation to develop a more detailed and tightly defined protocol to support future research efforts. This presentation will summarise the database and efforts to develop and test a protocol to support future research efforts. Modelling Options for developing an expanded role for modelling of drift profiles have been focussed upon evaluations of two models that have been used within a regulatory context in the EU: IDEFICS and the SSAU Arabale Crop Spray Drift Model. This presentation will report on model assessment efforts, potential future improvements in process representation and consider options for regulatory scenario development. Flexibility in risk mitigation An earlier workshop (SETAC MAgPIE) compiled a toolbox of risk mitigation measures in use in Europe and recommended development of communication tools to support broader and more effective implementation and encourage certification and testing harmonisation. This presentation will summarise the efforts underway in SETAC DRAW to realise these objectives through the creation of a platform to support exchange on scientific, technical, professional, and legislative or regulatory aspects of the toolbox, to further develop its accuracy and effectiveness (https://www.spraydriftmitigation.info/).

2 Plant uptake in regulatory environmental exposure assessment: Refined modelling based on experimental data

C. Schriever, BASF SE; Z. Guo, Bayer Crop Science Division; M. Lamshoef, Bayer CropScience AG / R&D; M. Reitz, H. Hesseler, Syngenta Agro GmbH; R. Sur, Bayer AG - Crop Science Division / Environmental Safety; P. Sweeney, Syngenta; P. Volz, BASF SE; S. Webb, Syngenta Ltd; B. Zillgens, Dupont GmbH A novel study design to determine plant uptake of chemicals for environmental fate modelling was developed and tested in a tiered approach. Ten laboratory organizations with different levels of experience with uptake testing participated in a round robin test and studied uptake of [14C]-1,2,4-triazole by wheat plants. Afterward, uptake of ten radiolabelled chemicals with various properties by potato, tomato or wheat plants was investigated in two laboratories. The findings showed acceptable inter-laboratory variability and proved the applicability of the design to various compound/crop combinations. Experimental Transpiration Stream Concentration Factor (TSCF) values were higher than calculated values, implying that the equation of Briggs et al. (1982) underestimates plant uptake of compounds with logKow values of less than 2. Results obtained with this study type are suggested to be used for regulatory environmental exposure assessments. These schemes are usually based on a tiered approach, where modelling with refined model parameters is one of the higher tier options. One example is the plant uptake factor that is considered e.g. in the course of the leaching assessment according to FOCUS Groundwater. Consideration of plant uptake (dissolved compound mass is taken up into plants with the soil porewater) decreases compound mass in soil and can lead to more realistic predicted environmental concentrations. Recent guidance proposes a default uptake factor of 0 for modelling and suggests two refinement options for TSCF values: factor 1 from the mass of compound Briggs et al. (1982) and the substance specific TSCF value from “uptake experiments with appropriate and agreed set-up to be developed” (EFSA, 2013; EU Com, 2014). The presented study design was explicitly developed to address the need identified by EFSA and was based on suggestions from the EUregPUF workshop (York, 2015) where participants from academia, authorities and industry met to establish an up to date understanding of plant uptake science. Lessons learned from the testing and continuous exchange with academia and authorities facilitated optimisation of the study design. The current version of the study design is considered appropriate to produce reliable data on plant uptake to be used as input for refined exposure modelling. An explicit guidance, however, on how to integrate the requested study design into the regulatory process is still lacking.

3 Work of a SETAC Group to Develop the Scientific Basis for Guidance for Regulatory Groundwater Monitoring of Crop Protection Products and their Metabolites in Europe

R.L. Jones, Bayer Crop Science Division / Environmental Safety; A. Gimsing, The Danish Environmental Protection Agency / Pesticides and Genetotechnology; J. Agert, Bayer CropScience AG / Environmental Safety; N. Baran, BRGM; A. Bobbe, BASF SE; F. Ferron, Counsil; J. Gibb, Environment Agency; T. Wolf, AgrarNiemand Ltd. In order to develop a more complete understanding of plant uptake science. Lessons learned from the EUregPUF workshop (York, 2013) where participants from academia, authorities and industry met to establish an up to date understanding of plant uptake science. Lessons learned from the testing and continuous exchange with academia and authorities facilitated optimisation of the

4 Effect of the Freundlich exponent on the finite penetration depth in a homogenous Freundlich-SFO leaching system

J. Boesten, Wageningen Environmental Research. A simplified model based on groundwater assessment since 2000 (PELMO, PEARL, PRZM and MACRO) are based on a Freundlich isotherm combined with a first-order (SFO) degradation of the pesticide concentration in total soil. Thus, this is one of the cornerstones of the EU regulatory leaching assessment. This assessment is based on the FOCUS groundwater scenarios which use weather series of tens of years and include crop development and heterogeneous soil profiles. The sensitivity of the FOCUS leaching concentration (evaluated at 1 m depth) to the parameter describing the curvature of the Freundlich isotherm (i.e. the Freundlich exponent N) as derived from simulations with these models shows a sharp decline with decreasing Freundlich exponent with the concentration going down to a submolcular level. This is counterintuitive and difficult to understand. Explanations may be found by studying a simplified version of these sophisticated models, i.e. a assuming a homogenous soil profile with pesticide properties that are constant with depth and assuming a constant water flow rate and a constant volume fraction of water (further called ‘simplified Freundlich-SFO system). Previously it was shown that a pulse of pesticide applied at the soil surface in this simplified system has a finite leaching depth beyond which no pesticide molecule goes. This pass. Simulation results of a few for a FOCUS groundwater scenarios were compared to this effect on the percentage leached with this simplified model and qualitatively these effects were found to be similar. Next it was shown that this finite penetration depth after infinite time in the simplified Freundlich-SFO system increases slowly when N increases from 0.5 to about 0.85; however, when N approaches 1, this finite penetration depth goes to infinity. This was expected because this finite penetration depth does only occur in a system with a Freundlich isotherm and not in a system with a linear isotherm. It was checked by inspection of a concentration profile of one of the FOCUS groundwater scenarios that these scenarios also show a finite penetration depth for low N values at the end
The characteristic time for uptake and loss and loss rate constants and C partitioning is f non DMER Ltd.; J. Parnis, Trent University / Cemistry on their Environmental Fate and Effects (I) Hydrophobic Chemicals and Mixtures: Reliable Investigations requires only few input data, is based on validated models and calculated the trend of toxic pressure and pesticide risk in Germany from 1996 to 2000, and 2013. The highest agreement of measured and modeled peak concentration data monitored in small European Union member states aim at reducing ecological risks exerted by pesticides which may act as preferential flow organisms will likely not reach toxic concentrations within the test duration which is usually 4-94h. Doucette et al. [3] reviewed foliage/air partitioning data in which the onset of a hydrophobic delay (HD) is apparent when Log K<sub>OW</sub> is developed for the prediction of uptake of hydrophobic chemicals by foliage. This model shows levelling off corresponding to insufficient time to achieve equilibrium. A kinetically limited regime is reached at a K<sub>OW</sub>=10<sup>4</sup>. In our presentation we will address the HD issue that we believe is a widespread phenomenon applicable to numerous environmental systems including passive sampling and partitioning to aerosol particles. Finally, we suggest a general method for identifying the HD problem. [1] Environ Sci Technol 2015, 49(19): 11913-22. [2] Environ Toxicol Chem 2012, 31(8):1911-9. [3] Environ Toxicol Chem. 2017, Accepted. [4] Environ Sci Technol 1999 33:1799-1804.

8 Partitioning of chlorinated paraffins (CPs) to organic matter is not class specific: implications for bioaccumulation? M. Castro, Stockholm University / ACES; M. Breitholtz, B. Yuan, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); I. Athanassiadis, Stockholm University; L. Asplund, A. Sobek, Stockholm University / ACES Chlorinated paraffins (CPs) belong to a group of industrial chemicals consisting of n-alkanes (from 10 to 30 carbon chain atoms) with chlorine content from 30% to 70% weight. They are widely used as high-pressure lubricants, flame retardants, and additives in plastic, rubber, and sealants, leading to high-production volumes worldwide. These chemicals are also ubiquitously found in the environment. The use of short chain chlorinated paraffins (SCCPs) in Europe has been restricted, however, medium (MCCPs) and long chain (LCCPs) chlorinated paraffins are used in Europe as substitutes for SCCPs. In some countries, all classes are still in use, leading to high production volumes (over a million tons per year globally). There is a lack of data on CP physicochemical and hazard-based properties, which is due to their inherent high complexity. CPs are hydrophobic contaminants, which complicates their aquatic toxicity testing. In this work, we validate the use of passive dosing for the study of chlorinated paraffins and parallel the partitioning behavior of CP technical mixtures between silicone, water and organic carbon. We used 5 different technical mixtures from three the established categories (2 SCCPs, 1 MCCP, 1 LCCP). We added Daphnia magna to the passive dosing system, to understand the partitioning behavior of CP technical mixtures from CP-dosed water medium to CP-free organic matter (K<sub>OW</sub>).\footnote{In our presentation we will address the HD issue that we believe is a widespread phenomenon applicable to numerous environmental systems including passive sampling and partitioning to aerosol particles. Finally, we suggest a general method for identifying the HD problem. [1] Environ Sci Technol 2015, 49(19): 11913-22. [2] Environ Toxicol Chem 2012, 31(8):1911-9. [3] Environ Toxicol Chem. 2017, Accepted. [4] Environ Sci Technol 1999 33:1799-1804.} Bioaccumulation of D. magna was observed after 48 hours under different exposure concentrations. APCLI-QTOF-MS was used for CP quantification. Both silicone-water and organic carbon-water partition coefficients overlap between different categories of CP technical mixtures. CP-52, labelled as a MCCCP, had a similar silicone-water partitioning coefficient as a restricted SCCP – Huels 70C. We demonstrate that increasing average chlorine content of each CP mixture significantly increases the log K<sub>OW</sub> values. Log K<sub>OW</sub> values were calculated on the basis of chlorination, k<sub>e</sub> and k<sub>a</sub> the uptake and loss rate constants and k<sub>i</sub> is k<sub>e</sub>/BCF where BCF is the bioconcentration factor. The characteristic time for uptake and loss t is L/K<sub>OW</sub>/k<sub>e</sub>. Slower uptake and loss will occur if the partition ratio K<sub>OW</sub> is large, and the fish must contact K<sub>OW</sub>L its own volume to approach equilibrium. Very hydrophobic substances will experience long time delays when approaching equilibrium and correspondingly long times for loss during a depuration phase. Mackay et al. [1] modeled bioconcentration and toxicity of superhydrophobic chemicals D4, D5, and D6 using a biotaupe model for fish. Due to the very high hydrophobicity (log K<sub>OW</sub>=10<sup>4</sup>) for D5 and very low water solubilities C<sub>OW</sub> must be very low, which results in a very long equilibration time. Uptake time to equilibrium for D5 was estimated to be ~2000 days, to get C<sub>WW</sub>=2 mol/m<sup>3</sup> about 17 days. The study concluded that for superhydrophobic substances organisms will likely not reach toxic concentrations within the test duration which is usually 4-94h. Doucette et al. [3] reviewed foliage/air partitioning data in which the onset of a hydrophobic delay (HD) is apparent when Log K<sub>OW</sub> is developed for the prediction of uptake of hydrophobic chemicals by foliage. This model shows levelling off corresponding to insufficient time to achieve equilibrium. A kinetically limited regime is reached at a K<sub>OW</sub>=10<sup>4</sup>. In our presentation we will address the HD issue that we believe is a widespread phenomenon applicable to numerous environmental systems including passive sampling and partitioning to aerosol particles. Finally, we suggest a general method for identifying the HD problem. [1] Environ Sci Technol 2015, 49(19): 11913-22. [2] Environ Toxicol Chem 2012, 31(8):1911-9. [3] Environ Toxicol Chem. 2017, Accepted. [4] Environ Sci Technol 1999 33:1799-1804.

9 Trophic magnification of cyclic volatile siloxanes (D4, D5, and D6) in a freshwater lake: A Monte-Carlo analysis K. Woodburn, The Dow Chemical Company / HES; R.M. Seston, Hyla Environmental Consulting, LLC / Toxicology, Environmental Research & Consulting; J. Kim, D.E. Powell, The Dow Chemical Company / Toxicology, Environmental Research & Consulting The trophic transfer of cyclic methylsiloxane (cVMS) materials in aquatic ecosystems is an important criterion for assessing bioaccumulation and ecological risk of these compounds. The key to determining cVMS biotransformation specifically octamethylcyclotetrasiloxane (D4), decamethylcyclopentasiloxane (D5), and dodecamethylcyclohexasiloxane (D6) was determined for the Lake Pepin, Minnesota (USA) food web. The objective of this work was to determine if cVMS materials are biomagnified in this freshwater ecosystem. To determine whether the benthic influence in the Lake Pepin aquatic food web affected the trophic magnification factor (TMF) values for the cVMS compounds, a companion study was conducted to determine the biomagnification and TMF value of a reference material, 2,3,3',4,4',5,5'-heptachlorobiphenyl (PCB-180), in Lake Pepin. TMFs for the three cVMS materials and PCB-180 were determined using standard
methods involving feeding guild, trophic guild classifications, and the stable isotopes of nitrogen (d15N) and carbon (d13C) to estimate trophic position/carb flow. The aquatic food web consisting of two benthic macroinvertebrate species and 15 fish species was evaluated for trophic magnification of cVMS materials and PCB-180. Lipid-normalized concentrations of D4, D5, and D6 were greatest in the lowest trophic levels and significantly decreased going up the food web, with the lowest concentrations being observed in the top predator. The TMF measured for the three cVMS materials were all 99% of the uncertainty for cVMS TMF values in Lake Pepin was explained by uncertainty at the base of the food web (89%) and at the top of the food web (11%). By comparison, PCB-180 had a TMF of 2.2 in the evaluated food web, indicating biomagnification. TMFs for the cVMS chemicals and PCB-180 were determined using a Monte–Carlo probability analysis technique, and the likelihood of the values exceeding unity was less than 0.5% for all three cVMS compounds and >99.5% for PCB-180. This evaluation indicates that D4, D5, and D6 do not biomagnify in the benthic–dominated Lake Pepin aquatic ecosystem, a food web which does demonstrate biomagnification of the legacy contaminant, PCB-180.

10 Distribution and Bioaccumulation of Polyhalogenated Carbazoles in Aquatic Systems from the United States and China

D. Chen, Jinan University / Cooperative Wildlife Research Laboratory and Department of Zoology; Y. Wu, Southern Illinois University Carbondale / Cooperative Wildlife Research Laboratory and Department of Zoology; R. Sutton, San Francisco State University Ecology Institute, K. Xu, Louisiana State University / Department of Oceanography and Coastal Sciences

The present study reports the discovery of a suite of polyhalogenated carbazoles (PHCzs) in aquatic sediments collected from four watersheds located in the United States and China, including the Gulf of Mexico (USA), San Francisco Bay (USA), Lake Tai (China), and Lake Dianshan (China), and their bioaccumulation in the San Francisco Bay estuary. A total of 11 halogenated carbazoles, including 3-chloro, 3,6-dichloro, 1,3,6,8-tetrachloro, 2,3,6,7-tetrachloro, 3-bromo, 2,7-dibromo, 3,6-dibromo, 3,6-dibromo-3,6-tribromo, 1,3,6,8-tetrabromo, 1-bromo-3,6-dichloro, and 1,8-dibromo-3,6-dichloro-carbazole were screened. Halogenated carbazoles were detected in 98.7% of the sediment samples, with concentrations ranging from below method limits of quantitation to 51.5 ng/g dry weight. In most of these sediment samples, PHCZ concentrations exceeded those of polynuclear aromatic hydrocarbons (PAHs). The latter group of chemicals has been determined to be persistent and globally distributed. PHCZs were also detected in various organisms from the San Francisco Bay, including bivalves, sport fish, harbor seal blubber and bird eggs. The median concentrations of PHCZs by species ranged from 33.7 to 164 ng/lipid weight. Biomagnification was also observed from fish to harbor seal and was mainly driven by chlorinated carbazoles, particularly 36-CCZ. Congener compositions differed among species, suggesting that individual congeners may be subject to different bioaccumulation or metabolism in species occupying various trophic levels in the studies system. Toxic equivalent (TEQ) values of PHCZs were determined on the basis of their relative effect potencies (REP) compared to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The median TEQ ranged from 4.8 to 19.5 pg TEQ/g lipid weight in biological tissues. Our data demonstrated the broad exposure of PHCZs in the studies systems and potentially in global aquatic systems. These findings raise the need of additional research to better elucidate their sources, environmental behavior, and fate in global environments.

11 Bioconcentration factors of contaminants of essential oils in fish determined in an in-vivo benchmarked dietary exposure study: A case study for pine oil

C.L. Chen, Stockholm University / Department of Environmental Science and Analytical Chemistry; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES); M. MacLeod, ITM - Stockholm University / Department of Environmental Science and Analytical Chemistry. Essential oils are fragrance materials that are registered as natural complex science and analytical chemistry (ACES); M. MacLeod, ITM - Stockholm University / Department of Environmental Science and Analytical Chemistry.

The present study reports the discovery of a suite of polyhalogenated carbazoles (PHCzs) in aquatic sediments collected from four watersheds located in the United States and China, including the Gulf of Mexico (USA), San Francisco Bay (USA), Lake Tai (China), and Lake Dianshan (China), and their bioaccumulation in the San Francisco Bay estuary. A total of 11 halogenated carbazoles, including 3-chloro, 3,6-dichloro, 1,3,6,8-tetrachloro, 2,3,6,7-tetrachloro, 3-bromo, 2,7-dibromo, 3,6-dibromo, 3,6-dibromo-3,6-tribromo, 1,3,6,8-tetrabromo, 1-bromo-3,6-dichloro, and 1,8-dibromo-3,6-dichloro-carbazole were screened. Halogenated carbazoles were detected in 98.7% of the sediment samples, with concentrations ranging from below method limits of quantitation to 51.5 ng/g dry weight. In most of these sediment samples, PHCZ concentrations exceeded those of polynuclear aromatic hydrocarbons (PAHs). The latter group of chemicals has been determined to be persistent and globally distributed. PHCZs were also detected in various organisms from the San Francisco Bay, including bivalves, sport fish, harbor seal blubber and bird eggs. The median concentrations of PHCZs by species ranged from 33.7 to 164 ng/lipid weight. Biomagnification was also observed from fish to harbor seal and was mainly driven by chlorinated carbazoles, particularly 36-CCZ. Congener compositions differed among species, suggesting that individual congeners may be subject to different bioaccumulation or metabolism in species occupying various trophic levels in the studies system. Toxic equivalent (TEQ) values of PHCZs were determined on the basis of their relative effect potencies (REP) compared to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The median TEQ ranged from 4.8 to 19.5 pg TEQ/g lipid weight in biological tissues. Our data demonstrated the broad exposure of PHCZs in the studies systems and potentially in global aquatic systems. These findings raise the need of additional research to better elucidate their sources, environmental behavior, and fate in global environments.

12 ROLE OF ADIPOSE TISSUE RESPONSIBLE FOR ECHOLOCATION IN THE BIOACCUMULATION PROCESS OF LIPOPHILIC COMPOUNDS IN HARBOUR PORPOISES

I. Schaar, Utrecht University; L. Gross, The University of Queensland / School of Earth Sciences; A. Mendoza Beltran, Leiden University; A. Covaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; T. Bouvexru, OCEAMM; F. Demaret, University of La Rochelle / Observatoire Pelagis; R. Blust, University of Antwerp / Department of Biology (SPHERE Research Group); M. van den Berg, Utrecht University / Institute for Risk Assessment Sciences; L. Wejs, Griffith University / Australian Rivers Institute Previous studies have suggested that persistent organic pollutants (POP) can lead to adverse effects in marine mammals, including harbour porpoises (phocoena phocoena), thereby causing illnesses. Traditionally, blubber is an ideal matrix to assess POP bioaccumulation in marine mammals. However, during times of energy deficits, blubber tissue is broken down in which POPs are redistributed in the body. Echolocating tissues melan and mandibular fat are inert lipid bodies in odontocetes and, in contrast with blubber, are less prone to release POPs, which makes them ultimate sinks for POP lifetime bioaccumulation. This study aimed to assess the lifetime bioaccumulation of POPs in harbour porpoises through 1) analysis of POPs in various tissues and/or organs of harbour porpoises, including lipid rich bodies as blubber, melan and mandibular fat, and 2) Physiologically based toxico-kinet (PBTK) modelling of PCB 153 and PBDE 153 to compare bioaccumulation of lipophilic compounds in lipid-rich tissues with different lipid composition and purpose (echolocation versus insulation) over the whole lifespan of male harbour porpoises. Overall, POP analysis and PCB 153 modelling for male harbour porpoises reveal that despite differences in lipid composition and lipid types, lipophilic pollutants bioaccumulation patterns are similar in blubber, mandibular fat and melan with increasing age. Nevertheless, the model showed the highest levels of PCB 153 in mandibular fat, followed by melan and blubber. From these results, mandibular fat can be considered as a sink for PCB 153 and a better proxy for lifetime exposure than blubber, which can be both a sink and source of lipophilic pollutants. PBDE 153 PBTK modelling reveals that bioaccumulation differs in lipid composition and lipid type, whereby bioaccumulation predominantly occurs in echolocating tissue during juvenile stage and in blubber during adulthood. Keywords: Echolocation, life time bioaccumulation, biomonitoring, PBTK modelling, POP

Interpretation and uncertainty - overcoming challenges of translating LCA results into reliable information

J. Guinee, University of Leiden / Institute of Environmental Sciences; R. Heijungs, Leiden University / Faculty of Economics and Business Administration Department of Econometrics and Operations Research; A. Mendoza Beltran, Leiden University; P. Henriksso, Stockholm University / Stockholm Resilience Centre; E. Groen, Areto Consulting GmbH / Animal production systems group

Environmental Life Cycle Assessment (LCA) relies on data, models and knowledge from almost all environmental scientific disciplines, including related uncertainties. In addition, LCA involves making methodological choices. Over the past five years, we have published several approaches to deal with data and methodological choice uncertainties. One often heard critique is that these proposals do not account yet for ‘correlations’. We distinguish between two meanings of the term ‘correlation’: correlated sampling: when applying Monte Carlo sampling for propagating uncertainty data for a comparative LCA study, the sampling can be either dependent (correlated) or independent (uncorrelated). Independent sampling implies that data of shared processes between the product alternatives compared, are sampled in different MC procedures resulting in different data sets for this shared process for both product alternatives. Dependent sampling implies that process data for the product alternatives compared are sampled based upon one and the same random drawing of parameter values resulting in identical data sets for this shared process; correlated data points: a transport process input of diesel is, for example, related to an output process of CO2 (emission); if the process consumes more diesel for the same amount of transport, the CO2 emission will also increase. The first interpretation of ‘correlation’ has been addressed in earlier work by Henriksso et al. and recently again by Mendoza et al. The second interpretation of ‘correlation’ (between data points) has recently been addressed by Groen et al. We present an overall framework integrating the different approaches correlated or independent sampling in LCA studies. In addition, we show the possibilities and limitations of also including data correlations into LCA uncertainty assessments. Practical application of this
Drivers of variability and uncertainty in the chemical footprint of personal care products

M. Douari, Radboud University Nijmegen; R. Oldenkamp, Radboud University Nijmegen / Department of Environmental Science; H. King, Unilever; R. University, J.A. Hendriks, Radboud University Nijmegen / Department of Environmental Science; A. Ficheux, A. Roudot, Université de Bretagne Occidentale; R. Van Zelm, Radboud University / Department of Environmental Science

Chemical footprinting of products, quantifying the potential environmental impact of the product’s chemicals, could be used to inform consumers choice. However, the use of chemical footprints (CFs) for comparative purposes requires a full understanding of the uncertainty and variability sources influencing its quantification. The goal of this work was to determine the CFs for personal care products and quantify the variability and uncertainty in the different parameters used to derive these individual CFs. In a first phase, we focused on shampoos. The environmental impact of each ingredient was derived from an environmental load, assuming 100% discharge to the drain, determined by the ingredient’s removal in activated sludge wastewater treatment plants (WWTPs) simulated using SimpleTreat, and a characterisation factor estimated with USEtox. The physico-chemical and ecotoxicological properties applied in both models were all estimated. Their reliability was derived from the prediction accuracy of the estimation models used (EPISuite, ACD Labs, ECOSAR). A Monte Carlo analysis with 1000 iterations was then performed, combining the uncertainty and variability of the different parameters, to determine the spread in CFs. The CFs derived by this approach spanned nearly 4 orders of magnitude (95% Confidence Interval (CI)). The wide span of the CI’s 95% CI was primarily attributable to fragrances (61%), surfactants (20%), and the scenario of products used (16%). The significant contribution from fragrances and surfactants can largely be explained by the uncertainty in their environmental impacts described by the characterisation factors derived with USEtox and more precisely the estimated ecotoxicology values. These preliminary results question the use of absolute values when communicating products’ chemical footprints. As long as more reliable ecotoxicological assessments are not available, identifying relative contributions to the overall environmental impacts might be more useful to target specific actions.

Combined uncertainty and scenario analysis within Life Cycle Assessment of waste management systems

V. Bisinella, DTU (Technical University of Denmark) / DTU Environment; K. Conradsen, DTU Technical University of Denmark / DTU Compute; T.H. Christensen, DTU Technical University of Denmark / DTU Environment; T. Astrup, Technical University of Denmark / Department of Environmental Engineering

Life Cycle Assessment (LCA) is being increasingly used for decision support in the waste management field. LCAs are subject to uncertainty regarding both the input data with parametrical uncertainty analysis, while epistemic uncertainty can be addressed with scenario analysis. However, the communicability and usefulness of the results can be hampered by the fact that such analyses are carried out separately, dividing the interpretation of the results in two separate channels and potentially limiting the value of LCA as a decision support tool. This study presents a novel method that aims at combining uncertainty and scenario analysis, illustrated on a case study on three hypothetical waste management options for treatment of residual household waste in the municipality of Copenhagen in 2025. The waste management solutions were provided with uncertainty for the model input values (parametrical uncertainty) and were assessed within four different hypothetical background conditions (scenario analysis). Within each impact category, the results of the parametrical uncertainty analysis were used to identify the most robust waste management option, i.e. the waste management option obtaining the highest average probability measure of providing the best environmental performance across the considered background scenarios. The method allowed obtaining various levels of analyses for the interpretation of the LCIA results: parametrical uncertainty analysis for each of the assessed waste management options, with identification of the parameters mostly contributing to the uncertainty around the results, within each of the assessed scenarios for the background conditions. This first stage was followed by a geometrical standpoint, LCIs of the ecoinvent database and impact categories of the ILCD method. Here, the RI is a proximity measurement between the standardized LCI vectors and standardized impact category vectors, corresponding to the cosine of the angle between two vectors. This measurement does not assess the relevance of the environmental model behind impact categories, but rather translates the main element flows from a LCI based on how they are represented by the impact categories of an LCIA method. Two inventories referred variability. Life Cycle Inventory (LCI) regionalization deals with this challenge as an illustrative example (areas analysed: NPCC, North-eastern North America, U.S. only, and Germany). Results show that comparing the NPCC and the German electricity mixes is more relevant based on the ionising radiation impact categories. The freshwater eutrophication, the climate change and the ozone depletion are the three other impact categories that focus on the main environmental issues that best represent the two LCIs. This analysis provides additional information for characterizing the impact categories towards LCI representativeness within the global context of a given database. While performing a LCA study, practitioners could benefit of the developed methodology to select impact categories to focus the results interpretation on relevant environmental issues.

Reduce the uncertainty of LCA results by prioritizing the regionalization effort: a sectorial meta-analysis

L. Patouillard, CIRAI G - École Polytechnique de Montréal; P. Collet, IFP Energies nouvelles; P. Lossage, CIRAI G - École Polytechnique de Montréal; P. Tiraico, CIRAI G; C. Buleon, CIRAI G - ÉSG - UQAM / Strategy & corporate social responsibility; M. Margni, CIRAI G - École Polytechnique de Montréal / Mathematical and Industrial engineering

Uncertainty in Life Cycle Assessment (LCA) can limit the results interpretation. Regionalization is one of the ways to reduce the uncertainty due to spatial variability. Life Cycle Inventory (LCI) regionalization deals with this issue by exploring the geographic representativeness modelled in LCI. Life Cycle Impact Assessment (LCIA) regionalization deals with regionalized impact characterization that accounts for the spatial variability of the receiving environment. Regionalized characterization factors (CF) apply to spatialized elementary flows (EF), called LCI spatialization. However, integrating regionalization requires additional effort on data collection and treatment for LCA practitioners and database developers. Thus, prioritizing the regionalization effort on the most sensitive data (input data with uncertainty having the highest influence on the resulting uncertainty) would ensure an optimal use of resources to reduce LCA results uncertainty. This research work proposes a procedure to prioritize regionalization efforts based on global sensitivity analysis (GSA) to reduce the spatial uncertainty of LCA results. We applied this procedure to all the activities of two economic sectors (biofuel production and passenger land transport) defined in the ecoinvent database v3. The regionalized impact methodology IMPACT World+ is used to assess environmental impacts. Statistical tests are then used to derive sectorial recommendations regarding the impact categories (IC) and LCA phases (LCI or LCIA) that should be regionalized in priority. Those recommendations mean that LCA practitioners and LCI database developers to define their strategy for regional data collection to lower the LCA results uncertainty. Results show that contrasting IC ranking depending on the economic sector. For the biofuel production sector, land transformation encompasses almost all the uncertainty, whereas it is distributed among several impacts (global warming and marine acidification) on the land passenger transport sector. For LCA phases ranking, it confirms that inventory should be spatialized in priority for regionalized impact categories. This methodology allows providing different recommendations specific a sector to refine data collection in order to reduce uncertainty and enhance results interpretation. To our knowledge, this is the first time that an uncertainty analysis discriminating IC and LCA phase ranking is performed.
Unravelling longitudinal pollution patterns in freshwaters by non-target screening and cluster analysis

L. Beckers, Helmholz-Zentrum für Umweltforschung GmbH - UFZ / Effect-Directed Analysis; W. Brack, E. Müller, T. Schulze, M. Krauss, Helmholz Centre for Environmental Research - UFZ / Effect-Directed Analysis

Pollution of aquatic ecosystems with emerging organic contaminants (EOCs) has been intensively studied over the past decades. The vast number of EOCs and their occurrence in complex and variable mixtures is a major challenge for monitoring, risk assessment and management and is beyond the scope of target screening. Thus, novel approaches are needed to characterize these mixtures and identify unknown EOCs including transformation products and natural background. In this study, we propose a novel workflow for unravelling pollution patterns along a river course by identifying longitudinal dynamics of pollutant groups, entry pathways and the fate of EOCs along the river course using non-target screening by LC-HRMS and cluster analysis. Sixteen grab samples were taken along the 42 km-long course of the Holtemme River (Saxony-Anhalt, Germany), whereas the first sampling in the national park marked a reference point for pristine conditions. Chemical screening was performed on an UltiMate 3000 LC system (Thermo Scientific) coupled to a hybrid quadrupole - Orbitrap MS (QExactive™Plus, Thermo Scientific) with a heated electrospray ionization source. MS/MS analysis was performed in a full scan experiment (100-1000 m/z) at a nominal resolving power of 140,000 at m/z 200. Peak extraction including peak picking, gap filling, componentization and target annotation was implemented in R. Cluster analysis was performed using the R package ‘kmL’. Four clusters were suggested for the data set representing: A: EOCs from treated wastewater input of the two wastewater treatment plants (WWTP), B: EOCs specific for first WWTP due to specific local emissions, C: EOCs from diffuse (i.e., agricultural and urban surface run-off) and small point-source input (e.g., rain sewers and creeks) and D: low continuous background signals. The identified patterns gave insights into the spatial dynamics of complex chemical mixtures along a river course, highlighting differences in point-sources and areas governed by diffuse input and identifying points of complex mixtures of mixtures (e.g., first WWTP). Deeper investigation including structure elucidation will resolve the origin of non-target signals in these clusters. The proposed workflow proved to be a fast method for unravelling pollution patterns in non-target HRMS data and may also apply to study other longitudinal data such as temporal dynamics in pollution at hotspots and comparison of treatment and transformation processes.

Tracing sewage-derived contaminants from mainland towards the ocean by high resolution mass spectrometry

P. Lara, Martin Luther University of Halle-Wittenberg / Physical Chemistry; A. Chiaia-Hernandez, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Chemistry; M. Biel, R. Baena-Nogueras, University of Cadiz / Department of Physical Chemistry; J. Hollender, Eawag / Environmental Chemistry

The estuaries are the ultimate sink of most of the organic synthetic compounds produced and consumed by humans. Among the different pollution sources affecting this environment, discharge of treated and untreated sewage from mainland is of high relevance due to its continuous input, high volume and poor efficiency of conventional wastewater treatment plants (WWTP) to remove many potentially harmful substances. Even after dilution, some of these contaminants may still be detected at low concentrations (ppt-ppb level), especially in coastal waters, and their effects over marine biota are still widely unknown. This work focused on identifying a wide range of polar and semipolar chemicals that can be detected in both WWTP influents and effluents, as well as in the receiving waters (rivers and estuaries) and even in the open ocean. In order to do this, we carried out several monitoring campaigns in the Gulf of Cadiz (Atlantic Ocean, SW Spain), sampling wastewater from one of the biggest local WWTPs in the area (Jerez de la Frontera, 250,000 inhabitants), adjacent surface river and coastal waters, and oceanic waters at different depths (down to 400 m) taken up to 50 km away from the coastline. Solid phase extraction followed by liquid-chromatography high resolution mass spectrometry were used in combination with statistical tools (e.g., principal component and cluster analyses), specific vendor and open-access software, and orthogonal data sets to tentatively identify more than 1,000 compounds being features persistent enough to be also detected in oceanic waters. These compounds included different classes of surfactants (e.g., alkylbenzybenzenesulfonates and their by-products, e.g., DATS) and metabolites (e.g., NPEC), polymers (PEG, PPG and many ethoxylated derivatives), pharmaceuticals (e.g., valsartan, diclofenac, carbamazepine, etc.), personal care products (UV stabilizers) and food additives (e.g., sucralose), some of them (e.g., sulfon) identified in the environment for the first time. The list of compounds reflected here not only shows many of the substances that can potentially escape from wastewater treatment but also constitutes a first step towards a more detailed characterization of the chemical exposure in the marine environment.

Pharmaceuticals, personal care products (PPCPs), and artificial sweeteners (ASWs) in river and groundwater from the Ganges River Basin, India

B. M. Shariff, Research Centre for Toxic Compounds in the Environment Faculty of Science Masaryk University / Faculty of Science; J. Bečanová, Graduate School of Oceanography, University of Rhode Island, Narragansett, Rhode Island 02882 / Chemical Oceanography; M. Scheringer, ETH Zurich / Institute for Chemical and Bioengineering; L. Nizzetto, NIVA

Pharmaceuticals and personal care products (PPCPs) and artificial sweeteners (ASWs) are environmental contaminants of emerging concern. In this study, we investigated the occurrence and distribution of 15 pharmaceuticals and personal care products (PPCPs) and five artificial sweeteners (ASWs) in surface and groundwater of the Ganges River Basin in India. The Ganges River Basin is the largest river basin in India and home of about 7% of the total global population. PPCPs and ASWs were ubiquitously present in the river and groundwater. Most frequently detected compounds were caffeine, DEET, ketoprofen, cyclopamine and sucralose. Except caffeine and DEET, concentrations of other PPCPs and ASWs in river water were found to be higher in densely populated areas. Concentrations of PPCPs and ASWs in the groundwater were lower but on same order as detected in the river water. Similar to river water, elevated concentrations of PPCPs and ASWs in groundwater were detected in middle and lower reaches along the Ganges River. PPCPs and ASWs concentrations were lower than those in developed countries, still, their instantaneous loads in the Ganges River were comparable to those in rivers from developed countries. The presence of PPCPs and ASWs in the surface and groundwater can be interpreted as a consequence of inefficient wastewater management in the basin, which pose a concern for human exposure.

Data-dependent fragment ion search for detection of sartans and related compounds in wastewater and surface water

B. Zojza, IDAEA-CSIC / Environmental Chemistry; M. López de Alda, Instituto de Environmental Assessment and Water Research IDAEA-CSIC / Department of Environmental Chemistry; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry

Presence of polar contaminants like angiotensin II receptor antagonist pharmaceuticals (sartans) in the aquatic system is directly linked to human impact. Like other xenobiotics, they can be metabolised in the body with enzymes such as cytochrome P450 (CYP), UDP-glucuronosyltransferase (UGT), and glutathione S-transferases (GST) which are present in the human liver at high abundance. Due to biological and/or abiotic processes that the contaminants undergo from the discharge site to the ground or surface water where they are detected, they can be transformed to transformation products (TPs). These TPs are usually detected and identified first at lab-scale in order to evaluate the degradability of a compound. This is typically followed by a targeted method development and it is not up until then that these TPs would have been shown. In some cases isolated, they are actually searched for in real aquatic samples to report their presence. Here, we propose an alternative approach, based on data-dependent fragment ion search, where real-world samples are initially screened for plausible TPs, metabolites or related compounds. The starting point here was a suspect screening of a list of all marketed sartans in wastewater effluent and surface water samples, which were extracted with a generic solid-phase extraction method using four cartridges with different chemistries. Out of the compounds detected, five of them had an identical core structure, and it was postulated that this sub-structure would fragment identically in all compounds. Following a series of experiments with different MS parameters modified, a list of hit compounds was obtained using fragment ion search. After all of the compounds investigated, available human metabolites and internal standards were purchased, a set of biodegradation experiments using activated sludge was performed in order to “source” the detected m/z and compare the possible TPs fragmentation to the one obtained in the bio-reactors. In parallel, a literature search for reported human metabolites was used to complement the identification of compounds detected in cases where no such compound was found to bio-form from the parent compound. Finally, a targeted method was developed for quantification of these sartans and related compounds in wastewater and surface water. This work was possible due to support from EU-FP7 programme (Solutions project), Merck (LC columns) and Biotage (SPE cartridges).

HR-MS non-target analysis for transformation products of emerging organic contaminants in wastewater fractions pre-screened by ELISA

R. J. Schneider, H. Hoffmann, BAM Federal Institute Materials Research and Testing / Department of Analytical Chemistry Reference Materials High-Resolution Mass Spectrometry has its benefits but still wastewater samples challenge the analyst on the quest for “unknowns”, metabolites and transformation products of emerging organic contaminants (EOCs). Their detection requires non-target analysis which involves not only costly instrumentation but also scientists with the time to plough through the enormous amount of data collected. An approach is presented using antibodies as selectors to pre-screen fractions of an
HPLC run for “binding” in order to detect hitherto unknown but structurally related compounds. Carbamazepine (CBZ), an anti-convulsant and anti-depressant, sulfaamethoxazole (SMX), an antimicrobial for humans, and estrone (E1), a hormone and estradiol metabolite have been studied by this LC-ELISA approach. Immunoassays had been developed for all compounds but overestimations of wastewater concentrations were frequent, with CBZ even at a constant level (+30 %) that did not result from the considered cross-reactivity to CBZ-30,11-epoxide (ca. 70 %) or 2-hydroxy-CBZ (14 %). Fractions from HPLC runs of pre-concentrated wastewater samples were collected into a 96-well glass plate in small aliquots, with fractions adapted to the desired resolution along the run. One plate is sufficient to collect a 30–40 min. run. The fractions were evaporated to dryness under a gentle stream of nitrogen. Before ELISA analysis, all fractions were reconstituted in 100 μl of 0.1% TOP-ESI-MS applied on a specifically “positive” fraction revealed an exact mass of m/z = 389.168 and a chlorine pattern. The compound is cetirizine, an antihistaminic. It appeared in our samples from spring on and was responsible for 20 % of the overestimation we found initially with the CBZ antibody. The LC-ELISA for SMX displayed a series of unidentified peaks in the ELISAGram. Careful analysis of the fractions led to the identification of N4-acetylsulfaamethoxazole, an SMX metabolite which is present in the samples. With estrone, interferes by polar matrix compounds eluting early could be identified.

24 Designing a risk based monitoring program for groundwater sources for drinking water production – based on target and suspect screening combined with clustering techniques

R. Sjers, KWR Watercycle Research Institute / Chemical Water Quality and Health; A. Brunner, B. Bajema, P. Bauerlein, KWR / Analytical and Environmental Chemistry; M. de Jonge, Vitens; Y. Fujita, M. Schriks, KWR Watercycle Research Institute; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; M. Fossi, S. Casini, Dept of Environmental Toxicology and Health

Drinking water utilities heavily invest in monitoring occurrence of chemicals in drinking water sources and produced drinking water. Worldwide, drinking water regulation prescribes drinking water limits for a limited number of chemicals, the EU Drinking Water Directive (EU DWD) for example lists drinking water limits for 26 organic and anorganic chemical parameters. However, most drinking water utilities monitor a broad set of parent chemicals and their transformation products, using both target, non-target and bioanalytical methods. The EU DWD stipulates that drinking water monitoring is performed in a more flexible way, provided protection of public health is ensured. Compared to surface water, groundwater is less intensively studied and monitored. However, groundwater can be highly influenced, by anthropogenic activities related to the land-say above the groundwater, by infiltrating surface water, by historical contamination as well as by activities in the sub-soil. The susceptibility of the groundwater aquifers to these pressures depends on soil type and groundwater hydrology. Chemical properties such as persistence and mobility and their retardation during groundwater flow are reflected in the spatio-temporal patterns of the chemicals. Treatment technology applied, such as filtration and sorption techniques, determines removal efficiencies during drinking water production for specific compounds. Water utility Vitens services drinking water in a large area in the Netherlands, mostly using groundwater as a source. Their set of chemical parameters in the monitoring program is one of the most large scale monitoring programs in the EU. The utility aims to prioritize their measured chemicals and develop a tailored risk-based monitoring program. We presented here is the risk-based monitoring program for all 63 supply zones involved, mostly consisting of groundwater. We use both target and non-target/suspect monitoring data and well characteristics. We use clustering techniques combined with prioritization techniques including substance properties and in vitro as well as in vivo toxicity information. We analyse full scale removal efficiencies by the treatment technologies applied. Finally we propose a risk based monitoring program.

Wildlife ecotoxicology: laboratory dosing studies to field population assessments (I)

25 An interspecies correlation model to predict acute dermal toxicity of plant protection products to terrestrial life stages of amphibians

L. Weltje, P. Janz, BASF SE, Crop Protection - Ecotoxicology; P. Sowig, Bayer CropScience / Ecotoxicology

In this presentation, a model to predict acute dermal toxicity of plant protection products to terrestrial life stages of amphibians is presented. Dermal toxicity experiments with 15 different species of anuran amphibians, comprising 15 different plant protection products. The developed ICE model can be used in a screening approach to estimate the acute risk to amphibian terrestrial life stages from dermal exposures to plant protection products with organic active substances. Applying this method has the potential to reduce unnecessary testing of vertebrates.

26 Overview of the EFSA Scientific Opinion on the state of the science on pesticide risk assessment for amphibians and reptiles

S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; P. Adriaanse, Alterra Wageningen University and Research Centre; A. Albrecht, Agroscope / Ecotoxicology; C. Berg, Uppsala university, Dept. of Environmental Toxicology / Dept of Environmental Toxicology; P. Berny, VETAGRO-SUP / Toxicology; K. Machera, Benaki Phytopathological Institute / Department of Pesticides Control & Phytopharmacy, Athens, Greece; M. Ortiz Santaliestra, Institute for Game and Wildlife Research (IREC) UCLM-CSIC-JCCM; C. Topping, University of Aarhus; S.M. Weir, Queens University of Charlotte / Biology; S. Friesell, EFSA / Pesticides Unit; R. Smith, School of Applied Sciences, University of Huddersfield

Concerns have been raised that the current risk assessment schemes may not sufficiently cover the risk for amphibians and reptiles exposed to intended uses of plant protection products (PPP). To address these concerns, the European Food Safety Authority (EFSA) has published a Scientific Opinion on the state of the science on pesticide risk assessment for amphibians and reptiles. EFSA Journal 2017; 329 pp. doi:10.2903/j.efsa.2017.2072. [2]. EFEC. 2009. Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market. OJ L 391/1

27 Ecotoxicological assessment of Caretta caretta (Linnaeus, 1758) in the Mediterranean Sea using an integrated non-invasive prototype

S. Casini, University of Siena / Scienze Fisiche della Terra e dell’Ambiente; I. Caliani, M. Giannetti, L. Marsili, S. Maltese, D. Coppola, N. Bianchi, T. Campanni, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Ancora, University of Siena / Physical sciences, Earth and environment; M. Fossi, University of Udine / Department of Environmental Sciences, Earth and Environment

Caretta caretta is the most common sea turtle in the Mediterranean Sea. The IUCN assessment for this carnivorous long-lived reptile underlines the lack of information regarding pollution and pathogens and indicates as a priority efforts to investigate and reduce the impacts of these threats. Up to now very few studies were conducted investigating biomarker and environmental contaminant assessment, such as the impact of oral and dermal exposure routes. Invertebrate studies are very difficult to perform with these organisms and risk mitigation options – if available - could usefully be included in risk assessment as an alternative to full-scale field studies. Practical mitigation options would need to be developed and adapted for local environments to be most effective. [1] EFSA PPR. 2017 Scientific Opinion on the state of the science on pesticide risk assessment for amphibians and reptiles. EFSA Journal 2017; 329 pp. doi:10.2903/j.efsa.2017.2072. [2]. EFEC. 2009. Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market. OJ L 391/1

The aim of our study was to conduct the first ecotoxicological assessment of this species in the Mediterranean sea using a non-invasive integrated methodology. We set up and applied a monitoring protocol which also includes endpoints, such as CYP1A, Lipid peroxidation, ENA assay, B esterases, never investigated before in this species. Seventy-five loggerhead turtles were sampled in a representative way in Italy (Rescue Center) and free-ranging along the Spanish coasts. Blood, skin and carapace samples were used to test biomarker responses and contaminant (OCs, PAHs, Pb, Cd, Hg) levels. We measured biomarkers of exposure to lipophilic contaminants (CYP1A in skin biopsies), biomarkers of indirect and direct effects investigating neurotic (esterases inhibition) and estrogenic (vitellogenin) effects, oxidative stress (lipid peroxidation) and genotoxicity (Comet and ENA assays) and liver damage (Gamma Glutamyl Transferase). Elaboration of experimental results was carried out taking also into consideration different age classes of the specimens. Among the main results obtained we should underline the statistically significant correlation between
carcinogenic PAHs in blood and DNA fragmentation as well as between Cd in carapace and GGT in plasma. We measured a very sharp band with a molecular weight of 59 kDa in skin sample that can be attributed to CYP1A. We never investigated earlier in this species. We also evidenced as the youngest animals showed significantly higher DNA fragmentations, BChE inhibition and increase of GGT; these alterations can be potentially related to their coastal habits. Older specimens showed the highest levels of erythrocyte nuclear abnormalities which may indicate a higher toxicological stress. This study contributed to expanded the knowledge about the ecotoxicology of C. caretta in the Mediterranean, the non-invasive protocol could also be applied to other marine ecosystems and other sea turtle species, and implemented with new endpoints in the near future.

28 Sucking clans or hunting seals - consequences to walrus health
H. Routti, The Norwegian Polar Institute; S. Bourgeois, University of Tromso / Department of Arctic Marine Biology; B. Diot, UT The Arctic University of Norway; N. Duaile, Norwegian Institute of Public Health; A.T. Fisk, University of Windsor / Great Lakes Institute for Environmental Research; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment; L. Hansen, M. Harju, NILU Norwegian Institute for Air Research; K.M. Kovacs, C. Lydersen, Norwegian Polar Institute; I. Nymo, Norwegian Veterinary Institute; C. Panti, University of Siena / Department of Physical Sciences, Earth and Environment; S. Scottor, M. Tryland, UT The Arctic University of Norway; G.D. Villanger, Norwegian Institute of Public Health

The walrus Odobenus rosmarus is an ice-associated marine mammal with distinct feeding habits. Concentrations of the main chlorinated pollutants, namely polychlorinated biphenyls (PCBs) and chlordane, in walruses that likely feed on seals are very high - similar to levels observed in polar bears, whereas pollutants concentrations in walruses feeding on benthos are lower. Although multiple studies have associated contaminant exposure to adverse health effects in polar bears and other marine mammals without contaminant exposure, there are no studies on toxicological endpoints of pollutants in walruses. The goal of our study was to investigate contaminant and pathogen exposure and endocrine disruption in walruses feeding at different trophic levels. Samples from adult male walruses (n=39) were collected from Svalbard, Norway. Stable isotope values determined in seven body compartments indicated that all of the walruses in this study fed at a low trophic level. However, concentrations of blubber lipophilic compounds showed very high individual variation. Concentrations of chlorinated compounds have decreased since they were last studied in walruses sampled, in the same area as the current study, during 2002-2004. Plasma PFAS concentrations varied less between individuals. δ13N values in red blood cells and in white blood cells positively correlate with δ15N levels in Hicular compounds, but not to PFASs. Antibodies against Brucella spp. and Toxoplasma gondii were detected in 26 % and 15 % of the walrus plasma samples, respectively. Presence of Brucella spp. and Toxoplasma gondii were not related to contaminant exposure or stable isotope values. Among the 5 thyroid hormone concentrations analyzed in plasma, concentrations of TT4 were negatively related to contaminant exposure. The next step, we analyzed transcript levels of 21 target genes in blood cells and 7 target genes in blubber related to endocrine and immune functions by real-time quantitative PCR. The preliminary results indicate few relationships between transcript levels of genes involved in endocrine functions and pollutant exposure.

29 Triclosan-induced embryotoxicity in the yellow-legged gull
C.D. Possenti, Università degli Studi di Milano; G. Poma, S. Defosset, University of Antwerp Toxicological Center; N. Saino, University of Milano; A. Covaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; M. Parolini, University of Milan / Department of Environmental Science and Policy.

Triclosan (TCS) is a chemical compound extensively used as synthetic and antimicrobial agent in a wide range of personal care products. Because of its hydrophobic nature and its discharge in the sewer system, TCS accumulates in settled sewage sludge and surface water, contaminating aquatic and terrestrial ecosystems. However, knowledge on the potential toxicity of TCS towards wildlife species is very scarce. Seabirds are highly exposed to environmental contamination because of their ecological habits, high trophic position in the food web and relative long life-span. Their eggs are a useful tool to monitor the levels of environmental pollutants and their potential adverse effects because these chemicals can be maternally-transferred to the offspring. However, such information on TCS is lacking. The aim of this study was to explore through in ovo injection, the potential embryotoxicity of TCS in the yellow-legged gull (Larus michahellis). In a within-clutch experimental design, 150 mg/g egg weight of TCS were injected into the egg yolk and the effects on embryo morphology, oxidative stress and genetic damage in embryo liver were investigated. Specifically, we assessed effects on embryo body mass, tarsus length and head size, as well as liver and brain mass. The amount of oxidant species (i.e. ROS), enzymatic activities (SOD, CAT, GST) and the levels of lipid peroxidation (LPO) were measured as biomarkers of oxidative stress, while levels of DNA fragmentation were measured as genetic damage endpoint. To check for the reliability of the injection method, we quantified TCS concentration in the yolk of unincubated eggs, while to assess its transfer to the embryo, we measured TCS in residual yolk and in the liver and brain. TCS concentrations in yolk from unincubated eggs were similar to the nominal ones (158.9±35.3 ng/g wet weight), while lower concentrations were found in residual yolk soon before hatching (2.9±1.1 ng/g wet weight). TCS was also detected in the liver (2.3±1.1 ng/g wet weight) and limited in the brain (0.2±0.1 ng/g wet weight). TCS treatment did not significantly affect embryo morphological traits. However, TCS significantly increased ROS levels and promoted GST activity, leading to a marginally non-significant increase of both oxidative and genetic damage. Thus, these findings demonstrated, for the first time in a wild bird species, that TCS may affect offspring phenotype and may represent a potential threat for coastal ecosystems.

30 Egg overspray with herbicides and fungicides reduces chick survival in red-legged partridges
M. Ortiz Santalices, Instituto für Game and Wildlife Research (IREC) UCLM-CSIC-JCCM; V. Alcalde, IRIAF/ Centro de Investigación Agroambiental El Chaparrillo; R. Mateo, IREC-CSIC - UCLM / Grupo de Toxicología de Fauna Silvestre; F. Mougeot, IREC

Toxicity characterization in pesticide risk assessment for birds is derived from oral exposure of adults. However, for ground-nesting species, a temporal and spatial overlap of egg laying and incubation with pesticide applications may result in direct exposure of the eggs. Using formulations commonly applied to cereal crops in spring, we conducted two experiments in it.<li> In the first experiment simulated egg overspray with pesticides and the second one the incubation of eggs on a soil that had been previously sprayed. For both experiments we used an application rate, corresponding to a 30% of the labelled application rate of each product (i.e. assuming a 70% interception by crop), and a control consisting of a water application in stead of pesticide formulations. Eggs were incubated at 37°C and 45% humidity until hatching (23-26 days). Sixteen eggs per treatment were removed from the experiment at different incubation times to analyse pesticide uptake (ongoing analyses, results will be presented at the meeting), and a minimum N=20 per treatment was monitored for embryonic development and post-hatching survival. Chicks were weighted and measured (tarsus length), and body condition calculated, at hatching and at days 8, 16, 24 and 32 post-hatching. Egg overspray with pesticides significantly increased chick mortality (Wald’s X² = 29.909, 14 d.f., p = 0.008). Although pesticides did not affect survivorship at hatching time, in ovo exposure to both 2,4-D and tebuconazole caused increased mortality of chicks afterwards, resulting in a reduction of productivity 32 days after hatching of 30.6 and 25.9%, respectively. Incubation of eggs in pesticide applied soils did not significantly affect chick survival (Wald’s X² = 15.603, 14 d.f., p = 0.338), and nestling growth was not affected in either experiment by embryonic exposure to pesticides. These results suggest that reduction of embryonic and chick survival because of egg overspray with pesticides can be a potential way by which these pesticides may affect reptile species in it. Likewise, potential 2,4-D and tebuconazole in the exposure period and effect occurrence need to be considered when monitoring pesticide impacts on avian reproductive output. Financed by the Spanish Ministry of Economy and Competitiveness (Project ref. CGL2016-75278-R)

Biocides and Veterinary Medicines: latest developments in regulatory risk assessment, research and monitoring

31 Regulatory improvement in the assessment of environmental risks from veterinary medicines; a European Perspective
J. Weeks, Joint Nature Conservation Committee

This presentation will focus on the developments in the environmental risk assessment of veterinary medicines from a European regulatory perspective. There is a need to continuously develop and react to changing requirements to perform more sophisticated, quantitative or robust environmental risk assessments for veterinary medicine products. The centralised approval of new veterinary medicines within the EU is the responsibility of the European Medicines Agency (EMA); however, developed best practices are shared by all member states. The EMA also aids in coordinating other European procedures with several member states involved. EMA frequently authorises and takes advice from specialist working parties aligned to the specific provision or modification of regulatory guidelines or procedures within the committee for veterinary medicine products (CVMP). One such group focuses on the improvement of the guidance to industry and other stakeholders on environmental risk assessment alongside the provision of reflection documents that aid understanding or address specific areas for clarification in regulatory procedures. The overview will highlight some of these recent developments, in improved regulatory advice for current or future procedures. It will summarily cover issues around assessing and limiting veterinary medicines in groundwater, the use of higher tier testing of dung fauna, the use of higher tier plant testing, improvements in PBT assessments, future plans developing improved guidance for the assessment of risks from aquaculture.
32 Risk of veterinary medicines to plants: Reflections for an updated approach. R. Carapeto Garcia, Spanish Medicines Agency / Veterinary medicines; A. Haro Castuera, Spanish Medicines Agency / Veterinary Medicines Department; G. Cortés Ruiz, C. Rubio Montejano, Spanish Medicines Agency / Department of Veterinary Medicines

In an Environmental Risk Assessment (ERA) the General Protections Goals need to be translated into Operational Protection Goals in order to achieve efficient and robust ERAs. Not doing so hinders the process of Risk Management in those cases where a risk is identified. In the current regulatory framework of ERA of Veterinary Medicines in the European Union, “the protection of ecosystems” is not translated into Operational Protection Goals. Hence, when risks are found it is complicated to manage or mitigate such risks. In the taxonomic level of “terrestrial plants” some VMPs have shown different levels of risks. From the Risk Assessor perspective it is difficult to deal with these risks, partly due to the lack of guidance on Operational Protection Goals. Here we analyze a proposal of usefulness of a Literature review, and used for exposure assessments at field scale, risk assessment of terrestrial plants: “Protection of Human Interest” and “Protection of Environmental Interests”.

33 Innovative environmental assessment of a veterinary medicinal product: watershed-level impacts of trenbolone acetate and 17β-estradiol J.P. Staveley, Q. Ma, J. M. Exponent; C. Celly, Intervet Int. dba Merck Animal Health; G. Scheef, MSD Animal Health Innovation GmbH / Preclinical Development

Environmental assessments of pharmaceuticals are required by regulatory authorities as part of the drug approval process. Revalor-XR is an extended-release implant for use in cattle fed in confinement (steers and heifers) that contains trenbolone acetate and 17β-estradiol (17β-E2) as active pharmaceutical ingredients (APhIs). Both APhIs are metabolized in situ resulting in the excretion of 17β-trenbolone (17TB-TB), 17α-trenbolone (17α-TB), trendione (TBO), 17β-E2, 17α-trenbolone (17α-E2), and estriol (E1). The similarity in chemical structures and modes of the environmental fate properties among 17β-TB, 17α-TB, TBO, and that among 17β-E2, 17α-E2, and E1 promote the use of surrogate compounds to represent the trenbolone compounds and the estradiol compounds in the environmental assessment. Data on the individual compounds were collected from various laboratory studies and literature sources, aggregated to generate representative values for the surrogate compounds to characterize their environmental fate, and used for exposure assessments at field scale and watershed-scales. Nine exposure pathways were evaluated at the feedlot and field scale, allowing for elimination of insignificant pathways for the watershed-scale modeling, which considered the major exposure pathways and was conducted for two representative watersheds, one in Texas and one in Iowa, using the U.S. EPA’s BASINS/HSPF model. The outputs of the modeling efforts resulted in Predicted Environmental Concentrations (PECs) for the surrogate compounds for individual as well as aggregated exposure pathways. The effects assessment was focused on potential reproductive impacts to fish from chronic exposure, which is the most sensitive ecological endpoint for these compounds, and generated Predicted No-Effect Concentrations (PNECs) for 17β-TB, 17α-TB, 17α-E2, and 17β-E2. Risk characterization involved comparison of the PECs for the surrogate compounds to the PNECs of the individual compounds. The assessment at the watershed scale demonstrated that it is highly unlikely that the compounds associated with Revalor-XR would have any significant environmental impacts when used according to the Revalor-XR label. The environmental assessment supported a Finding of No Significant Impact by the U.S. Food and Drug Administration from the use of Revalor-XR in beef steers and heifers in the U.S.

34 How can mesocosm studies increase realism in risk assessment of biocides and veterinary medicines? L. Dören, ERK / Product Stewardship; U. Hommen, Fraunhofer IEM; P. Ebke, Institute DSM GmbH Institut für Gewässerschutz; R. Drvenic, Justus Liebig University Giessen / Research Centre for BioSystems, Land Use, and Nutrition (IFZ), Institute of Soil Science and Soil Conservation

Mesocosm studies can be used to assess the environmental impact of potential stressors based on model-ecosystems under realistic environmental conditions. They are an important link from laboratory to field. Mesocosms provide the assessment of a broad range of different species of different ecological groups forming food webs with complex interactions. Therefore mesocosm studies can support a better understanding of the environmental impact of stressors on population level as well as on ecosystem level (e.g. direct and indirect effects on community structure and ecosystem functions as primary production). In addition, mesocosm studies provide data on the fate of test substances under realistic outdoor conditions, which can be used to test the prediction based on laboratory studies. While for the risk assessment of Plant Protection Products (PPP) mesocosm studies are an established higher tier approach and are considered as the surrogate reference tier, the use of mesocosm studies for risk assessment of biocides, veterinary medicines and chemicals under REACH is rare, although mesocosm studies have been recommended in the Guidance on the Generation of Toxicological and chemical safety assessment - Chapter R.10: Characterisation of dose [concentration]-response for environment and in the Guidance on the Biocidal Products Regulation - Volume IV Environment - Assessment and Evaluation both provided by ECHA. One reason for this might be, that mesocosms studies have the reputation to be very complex and difficult to evaluate by regulatory assessors. This presentation intends to take some fears of contact with mesocosms. It will explain the most important aspects to validate the quality of a mesocosm study and the relevance of the results. Further, it will give some insights to the use of (aquatic) mesocosm studies in the context of PPP risk assessment and will provide important aspects for planning a mesocosm study for biocides, veterinary medicines and chemicals in the context of REACH.

35 Estimation of insecticides in farm lands R.G. Ovesen, Danish Environmental Protection Agency; H. Bækgård, Kopenhagen Fur

Biocides are regulated in EU by the BPR [1]. To evaluate if an active substance (a.i.) or product may be authorised, an assessment of the environmental exposure is required. For insecticides used in stables an Emission Scenario Document (ESD) [2] is used covering application methods and a range of animal categories. The ESD does not cover biocides used in farm sands. A scenario has therefore been developed, where emission of a.i. from farm sands is calculated based on either amount applied or measured concentration in straw. Default values have been established from regulation and general practice in mink production in the Nordic countries, where Denmark has the highest production of mink in Europe [3]. Each breeding animal is kept individually in one cage to be treated at the start of the season. Mother and cubs stay together in one cage and are separated into pairs after lactation, where all cages are retreated. Each mother will bear 5.5 bushes/year according to Danish regulation [4]. The number of “breeding females” (BF) is 1 mother+5.5 cub. The number of nest boxes that is treated/BF may be calculated as follows: 1 animal/nest box before separation and 6.55/2 animals (3.257) nest boxes after separation. In Europe it is prohibited to discharge waste from stables to public sewer. Emission is therefore only expected to be to agricultural land. Emission of manure/straw may be drawn to 50 BF per hectare (ha) per year based on regulation in the Nordic countries. Emission according to application pattern: Y = Qav x Fapp x x (Napp before sep + 3.257 x Napp after sep) x B x 10^4 (Eq. 1) Where Y is emission of a.i. in kg/ha x year, Qav is amount of product/nest box in g, Fapp is concentration of a.i. in the product kg/g, Napp before sep is number of treatments before separation of adults and cubs, Napp after sep is number of treatments after separation of adults and cubs and B is amount of straw/manure that may be applied to land in number of BF/ha (B = 50). Emission based on amount of straw/manure applied to the field: Y = Concentration of a.i. in straw/manure x 750 kg straw per BF per ha (Eq. 2) Where amount of straw used per BF is 10-15 kg/year according to Kopenhagen Fur. The emission based on Nordic countries regulations and information from Kopenhagen Fur on amount of straw used per BF is 50 BF per ha x 15 kg straw per BF=750 kg straw per BF per ha. Predicted Environmental Concentration in soil may be calculated according to Volume IV Part B [5].

36 Biocidal active substances in municipal wastewater - what product groups are the sources? S. Wieck, Leuphana University of Lüneburg / Institute for Sustainable and Environmental Chemistry; O. Olsson, Leuphana University of Lüneburg / Institute for Sustainable and Environmental Chemistry; K. Kümmerer, Leuphana University of Lüneburg / Institute of Sustainable and Environmental Chemistry

The emission sources of biocidal active substances in households have been under discussion since these substances have been detected frequently in municipal wastewater. The emission from households like e.g. facades, however, has already been discussed in detail. However, until now the specific sources from the interior of these households remained unknown. To investigate the products responsible for these emission to wastewater, we analysed the wastewater of one neighbourhood for a set of biocidal active substances and compared these results with household product inventories. Time-proportional sampling of daily samples was conducted during one year for one household. The 14 substances analysed with an LC-MS/MS method were BIT, C12-benzalkonium chloride, carbendazim, CMIT, DCOIT, DEET, diuron, icaridine, OIT, piperonyl butoxide (PBO), triclosan, tebuconazole, terbutryn and tetramethrin. In comparison with data available from household product inventories of this neighbourhood, we investigated the product groups possibly being responsible for the emissions to the wastewater. Except for C12-benzalkonium chloride, tetramethrin and tebuconazole, all substances have been detected in at least 10 % of the samples. Highest concentrations were measured for C12-benzalkonium chloride with an average concentration of 6.6 µg/L. Besides C12-benzalkonium chloride, BIT, DCOIT and icaridine were measured in all samples. The results show...
that washing and cleaning agents are important sources for preservatives such as BIT and OFF, while triclosan was apparently mainly emitted through personal care products. The mosquito repellent substances DEET and icaridin were found throughout the whole year, with highest emissions in summer and autumn. C12-benzalkonium chloride concentrations were associated with the inventoried disinfectants. Material preservatives such as terbutryn, diuron, tebuconazole or cinnamaldehyde were also detected. As these were not listed on the inventoried products, emission via treated materials such as paint, render, seals or textiles seems likely. We were able to show that biocidal active substances are emitted from the inside of households in considerable concentrations. Those emissions are not only due to biocidal products but also washing and cleaning agents, personal care products and preserved materials. For this reason, measures should not only tackle biocidal products but when it comes to the reduction of biocidal active substances in wastewater.

The environment as a reactor determining fate and toxicity of nanomaterials (I)

37 Comparative multi-generation study of long-term effects of pristine and wastewater-borne silver and titanium dioxide nanoparticles on reproduction in Daphnia magna

S. Hartmann, University of Siegen, Institute of Biology / Department of Chemistry and Biology; R. Louch, University of Manchester; R. Zeumer, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Bioaccumulation and Animal Metabolism; C. Schlechtriem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; K. Witte, University of Siegen / Department of Chemistry and Biology

Manufactured nanomaterials (MNMs) and especially Ag- and TiO2-NPs are processed in daily-used products such as cosmetics, clothing and in medical supplies. After passing wastewater treatment plants these MNMs reach the aquatic environment and can accumulate in the aquatic ecosystem and cause toxicity to aquatic organisms. To assess the risk potential of these MNPs to aquatic invertebrates under more realistic circumstances, we investigated and compared possible effects of pristine Ag-NPs and TiO2-NPs with those after passing a model wastewater treatment plant on the reproductive success (number of offspring), mortality and body size of adult daphnia as endpoints in up to six generations. We exposed daphnia to: (i) pristine Ag-NPs (NM300K) and TiO2-NPs (NM105) or (ii) wastewater borne Ag- and TiO2-Nanoparticles from effluent from the model WWTP. The first generation of daphnia was exposed to four concentrations of Ag-NPs (nominal: 1.25 µgL⁻¹, 2.5 µgL⁻¹, 5.0 µgL⁻¹ and 10.0 µgL⁻¹), to solvent control (NM100K DIS), or to three concentrations of TiO2-NPs (nominal: 25 µgL⁻¹, 50 µgL⁻¹, 100 µgL⁻¹) in line with the OECD guideline No. 211. Each generation was exposed for 21 days and started with the third brood from the previous one. In all six generations the exposure with pristine Ag-NPs (NM300K) for 21 days caused a significant reduction in the mean number of offspring in daphnia compared to the control. However, wastewater-borne Ag-NPs had no effects on reproduction in any generation. In the treatment with body length dependent daphnia was significantly larger at 5 µgL⁻¹ in generation F2 and at 2.5 µgL⁻¹ in generation F3 compared to the control. In the wastewater-borne Ag-NP treatment the adults’ body length was significantly larger at 2.5 µgL⁻¹. Thus, adult’s body length showed no consistent pattern between both scenarios. When passing WWTPs most Ag-NPs might be transformed and enter the aquatic environment as silver sulfide. That may be the reason for the lower toxicity than compared to other forms of Ag-NPs. Our results provide a first, direct comparison between the toxicity of pristine Ag-NPs and TiO2-NPs with those from WWTP. To our knowledge, the present study is the first one showing that Ag-NPs from a wastewater treatment plant had a minor and no chronic toxicity to Daphnia magna. The used experimental approach allows a more realistic risk assessment of Ag-NPs and TiO2-NPs for the aquatic environment. The experiment with TiO2-NPs are in progress.

38 Development of a rapid screen to assess bioaccumulation potential: from ex vivo to in vivo using pristine and aged nanomaterials in fish

N. Clark, School of Biological Sciences, Plymouth University; D. Boyle, Plymouth University; R. Handy, University of Plymouth

Bioaccumulation is one of the key triggers of concern for environmental risk assessment that has had little consideration for engineered nanomaterials (ENMs). Given that ENMs undergo surface chemical reactions, agglomerate and sediment, the likely exposure route to higher trophic organisms (e.g., fish) is through the diet. Here we address the suitability of an ex vivo gut sac culture technique to estimate the bioaccumulation potential of pristine (Ag NPs) and environmentally aged (Ag:S NPs) materials. Additionally, we assess whether the results of the gut sac experiment can predict in vivo chronic dietary exposure. The gut sacs were prepared by removing the entire gastrointestinal tract and separating it into the oesophagus, stomach, anterior, mid and hind intestine compartments. Compartments were exposed by filling the lumen with one of four solutions: physiological gut saline or saline spiked with 1 mg/L Ag as AgNO3, Ag NP or Ag:Sn NP. Following a 4 h exposure, tissues were cut open and the mucosa was separated from the underlying musculature, through scraping via a microscope slide. For the in vivo chronic dietary exposure, fish (n = 150) were graded into tanks (n = 3 tank/treatment). Fish were fed either a control (no added Ag), 100 mg/kg as AgNO3, Ag NPs or Ag:Sn NPs. Fish were sampled each week (1, 2, 3 and 4; n = 2 fish/tank/time point). Following this, all tanks were placed on the control diet for another two weeks to measure Ag elimination. During sampling, the mid and hind intestine, liver, gill, bladder, kidney, spleen, gut sacs and carcasses were dissected. Tissues from both experiments were analysed for total Ag using ICP-MS. The gut sac experiment demonstrates the uptake of Ag is associated with the mid and hind intestine. There was significantly less Ag in the muscularis of the mid and hind intestine after exposure to Ag NP and Ag:S NP compared to AgNO3, but no difference between ENM treatments. The in vivo experiment demonstrated the same significance in Ag the mid and hind intestine of Ag NP and Ag:TiO2-NPs compared to Ag:Sn NPs. Short from all the exposures were able to pass the gut epithelium and cause total concentrations in the liver to rise, despite the form being unknown. In conclusion, the ex vivo gut sac method can be used to rapidly screen the bioavailability of Ag NPs and Ag:S NPs. However, if the data are ranked in the mid and hind intestine by total Ag accumulation, the gut sac does not directly predict in vivo accumulation.

39 Fate and Effect of Wastewater Borne Manufactured Nanomaterials on the Aquatic Food Chain

R. Zeumer, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Bioaccumulation and Animal Metabolism; B. Knopf, Fraunhofer Institute for Biochemical medicine and Lipid Endocrinology; I. Lopes, Fraunhofer IME / Ecological chemistry; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro, V. Galhano, Department of Biology & CESAM - University of Aveiro / Biology (dBio); M. Monteiro, Aveiro University / Biology; S. Loureiro, Universidade de Aveiro / Biology; C. Schlechtriem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism

Manufactured nanomaterials (MNMs) are widely used in various applications and commercial products, e.g. textiles, sunscreens, paints, cosmetics etc. Even though MNMs are mostly removed during wastewater treatment, the remaining and mostly transformed MNMs in the treated wastewater are significant and may show an increased toxicity for aquatic organisms due to their modification during the WWT. The impact of wastewater-borne MNMs (TiO2 and Ag MNMs) on different trophic levels and their bioaccumulation within a relevant food chain (algae-Daphnia-fish) have been investigated with innovative analytical and experimental approaches. Several model WWTPs were conducted according to OECD Guideline 304A. The collected effluents were used to perform acute and chronic tests with Daphnia magna and Oncorhynchus mykiss according to the OECD guidelines 202, 211, 215 and 305. Animals were exposed to (i) effluent from model WWTPs contaminated with MNMs, (ii) uncontaminated effluent, manually spiked with MNMs and (iii) dilution water enriched with pristine MNMs. Tissue samples of the different test organisms were analyzed for changes in the levels of several biochemical markers [lactate dehydrogenase (LDH), superoxide dismutase (SOD), catalase (CAT) and glutathione S-transferase (GST)]. Furthermore, uptake and elimination kinetics of the MNMs were investigated by quantitative ICP-MS and ICP-OES analysis. No chronic effects were found in D. magna after exposure to effluents with transformed AgNPs. However, when supplemented into uncontaminated effluents with continuous feeding, the analysis of Ag uptake per adult daphnia showed a significant increase in AgNP concentration. For nano-TiO2, no effects on the reproduction of D. magna could be shown at environmentally relevant concentrations. Only after chronic exposure to the very high concentrations of 5 mg/L and 10 mg/L significant effects could be shown. Neither nano-Ag nor nano-TiO2 showed an effect on the growth of juvenile rainbow trout after 28 days of exposure. The analysis of biochemical markers showed that several effects induced by chronic exposure to MNMs were observed. However, no general effect pattern could be identified. Total MNM levels were measured in several tissue samples in D. magna and O. mykiss following exposure via the water or food. Pristine nanomaterials showed a significantly higher uptake into the test organisms compared to supplemented and treated WWTP effluents.

40 Uptake and elimination kinetics of pristine and aged silver nanoparticles in freshwater benthic organisms

P. Silva, Universidade de Aveiro; C. van Gestel, Vrije Universiteit Amsterdam / Department of Ecological Science; R.A. Kinkel, University of Aveiro / Department of Ecological Science; S. Loureiro, Universidade de Aveiro / Biology

Manufactured Nanomaterials (NMs) can undergo changes in their properties and behaviour during application and disposal. Once in the environment, different forms of NMs can be taken up by organisms and suffer biologically-driven alterations. Toxicokinetic modelling can provide important information about ways of uptake, internal processing and elimination of NMs. Freshwater systems are important sinks for NMs, especially considering the sediment phase, where benthic organisms can be exposed through both water and sediment. Considering this, the aim of the present study was to determine the uptake and elimination constant rates of pristine and
was established and combined with a battery of ecotoxicological assays and characterization techniques. The system contained activated sludge and was operated as a pre-denitrification system fed with synthetic wastewater spiked daily with 10 µg Ag NPs/L (PVP coated, 25 nm, nanoComposix) and 100 µg TiO$_2$ NPs/L (nominal primary size of 5 nm, NM-101, JRC) over a period of 5 weeks. During that period the effluents were collected weekly and the excess sludge was stored for the evaluation of terrestrial bioavailability. Some samples from activated sludge were collected weekly and analyzed by sequential filtration and ICP-MS to determine the partitioning of NPs and their transformation products. Transmission electron microscopy and sp-ICP-MS were performed on selected samples. The effects of aged particles were assessed using a battery of bioassays including freshwater and marine algae (growth inhibition and reactive oxygen species -ROS- formation), crustaceans, as well as in vitro models of relevance for NP toxicity assessment (RTgll-W cell line, effects on metabolic activity, epithelial integrity, ROS formation, gene expression). The extent of the observed effects was dependent on the organism exposed, with bottom feeding organisms and algae being more sensitive, while the in vitro model was a good tool for environmental samples. Furthermore, the biosolids generated from the lab-scale continuous system were used for terrestrial microcosm experiments, giving insights into the fate and potential accumulation in a model terrestrial system. Experimental data generated from the continuous-flow operation of the activated sludge system and the targeted batch experiments will be used to model the fate and the removal of NPs.

Advances in environmental risk assessment of oil spills and offshore oil & gas operations (I)

43 Optimization of Oil Spill Response Planning and Preparedness Using Spill Mitigation Impact Assessment (SIMA)

P. D. McIlvaine, P. Robinson, H. R. Diro, Rambo/ Ecological Services

Oil spill emergency response plans (OSRP) are required as part of permitting for offshore operations. An OSRP typically includes risk assessment and detailed plans for responding to different types of oil spill accidents involving shipping, pipelines, platforms, and/or subsea wells. The owner/operator must demonstrate to state and federal regulatory authorities that the company’s OSRP for offshore exploration and production operations conform to all applicable regulations and international standards and practices, and further demonstrate that the necessary equipment and trained personnel are in place to respond quickly and effectively to an oil spill accident. In the event of an oil spill accident, the priorities for oil spill response (OSR) are to protect people, prevent or mitigate environmental damages, and prevent impact to affected communities. Spill Impact Mitigation Assessment (SIMA) is a science-based framework evolved from Net Environmental Benefits Analysis (NEBA) to broaden the focus from consideration of mitigation of ecological impact to include mitigation of socioeconomic and cultural impacts, as well. SIMA is a method for identifying and comparing the socio-environmental and -economic benefits of alternative OSR options, with the goal of selecting options that best mitigate the consequences of spilled oil and impose the lowest additional negative consequences on environmental and social resources. SIMA is both site- and spill-specific, and is particularly useful during the initial planning and preparedness period for oil and gas exploration and when new technologies and best practices emerge that need to be adopted into safety, health and environmental programs. This paper describes a spill impact mitigation assessment framework using recent examples of OSRP work conducted for the Arctic Oil Spill Response Technology Joint Industry Project, American Petroleum Institute Gulf of Mexico Deepwater Project, and several companies working in tropical marine environments. The applicability of SIMA to marine resources and habitats is also discussed. The SIMA framework typically includes (a) assessment of initial impacts and potential consequences in the marine environment, and (b) effectiveness and consequences of deploying different spill response strategies.

44 Adapting the SIMA Process to Assess Offshore Decommissioning Options

T. Coolbaugh, ExxonMobil Research & Engineering; A. Aziz, ExxonMobil Upstream Exploration Research Company; P. Taylor, Petronia Consulting Limited; G. Coelho, Spons Group Inc.

For several decades, the oil and gas industry has used the Net Environmental Benefit Analysis (NEBA) approach for oil spill response contingency planning. Recently, IPSEA-API-IOGP published guidelines on the implementation of NEBA, using a novel process known as Spill Impact Mitigation Assessment (SIMA). This paper describes a spill impact mitigation assessment framework using recent examples of OSRP work conducted for the Arctic Oil Spill Response Technology Joint Industry Project, American Petroleum Institute Gulf of Mexico Deepwater Project, and several companies working in tropical marine environments. The applicability of SIMA to marine resources and habitats is also discussed. The SIMA framework typically includes (a) assessment of initial impacts and potential consequences in the marine environment, and (b) effectiveness and consequences of deploying different spill response strategies.
drawbacks of each option, thereby developing response strategy. Similarly, oil and gas operators are faced with complex options for decommissioning offshore installations as part of their decommissioning plans. There is a need to evaluate these options in a scientifically-defensible and consistent manner, while adequately assessing risks that can be challenging to assess. An adapted SIMA process could be a valuable tool for fostering collaboration between operators, stakeholders and regulators, all while ensuring a transparent review of engineering studies and available decommissioning options in a meaningful way. This paper evaluates the use of the SIMA process in a hypothetical decommissioning of an offshore platform to determine if this process lends itself to this purpose. It describes the challenges encountered when trying to conduct this comparative risk assessment, originally intended for oil spill response, to the task of decommissioning. Finally, it proposes adaptations to the SIMA process that might enable its use in the future as a credible tool in assessing environmental risks for oil and gas decommissioning.

45 Detection and quantification of oil contamination in vegetated areas using hyperspectral remote sensing
G. Lassalle, ONERA; S. Sauter, ONERA / Optics and Associated Technologies; A. Credoz, R. Hédaq, TOTAL SA / Environment; P. Bordieries, ONERA / DEMR; G. Bertoni, INRA / Dynafor; D. Dubucq, TOTAL SA; A. Elger, University of Toulouse in Ecolab.

The detection and quantification of oil contamination in vegetated areas is a complex and challenging task. It is essential that the lessons of DWHOS are applied globally to prevent future oil spills. In this presentation, we demonstrate a convenient tool for keeping track of the large amount of impacts of the next big marine oil spill, wherever it may happen.

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46 A tool for tracking complex ecotoxicological effect data after large pollution events with use of the Deepwater Horizon oil spill as a case study
J. Beyer, NIVA - Norwegian Institute for Water Research; H.C. Tramum, T. Bakk, Norwegian Institute for Water Research; P.V. Hodson, Queens University / School of Environmental Studies; T.K. Collier, Delta Independent Science Board Ninth Street Suite 6 Sacramento CA

The Deepwater Horizon Oil Spill (DWHOS) in 2010 is the largest and most studied accidental marine oil spill in history. More than 100 new research studies were funded by the European Commission Horizon 2020 programme and the Government of Greenland. The study included experiments of natural removal of a crude oil and a heavy fuel oil from site mimicking rocky shore substratum and was run in the period from May-September 2017. The tiles were placed in different height levels of the tidal zone, and hence natural removal and degradation rates in correlation to different water cover regimes and air exposure times were obtained. The oil remains on the tiles were analysed for chemical compositions. A pilot scale costal in situ burning operation was performed during summer in a bay in western Greenland with a crude oil for testing burning efficiency and environmental exposure and effects. The studies were funded by the European Commission Horizon 2020 programme and the Government of Greenland.

47 Oil spill combat and effects in the Arctic coastal environment; self-cleaning potential and in situ burning
S. Wegeberg, Aarhus University / Department of Bioscience; J. Fritt-Rasmussen, Aarhus University / Department of Bioscience - Arctic Environment; O. Gjestvang-Hansen, M.R. Larsen, Greenland Institute of Natural Resources; K. Gustavson, Aarhus University / Department of Bioscience - Arctic Environment

What is the environmental effects of a beaching oil spill in the Arctic, how well will the shoreline potentially be able to self-clean and will combusting the oil by in situ burning at the coast just do more harm to the communities in the tidal zone? To answer these questions, several studies have been performed at the west coast of Greenland in 2016 and 2017. One aim of the studies was then to support net environmental benefit analysis, NEBA, related to oil spill in Arctic waters. A NEBA is often performed to achieve the optimal environmental effect with respect to choice of oil spill combat methodology and biology at risk. Hence, a synthesis will be presented of following studies: 1) removal rate and ecotoxicological effects of oil smother on seaweed (Fucus distichus), an important organism of the communities in the coastal tidal zone; 2) self-cleaning potential of a coastal line, including natural removal by seawater wash and physical degradation; and 3) effects on the tidal communities after combat of a beaching oil spill by in situ burning. Effects of oil smothering of the macroalgae Fucus distichus, which inhabit the intertidal zone of the coasts in the Arctic, as well as its self-cleaning potential by wash in sea were studied over a period of 2 weeks in a field test at Disko Island on the Greenland west coast. The studies were performed during a transparent review of engineering studies and associated applications, microbial oil degradation, oil monitoring after marine pollution disasters, using the DWHOS as a case study. In this presentation, we provide a convenient tool for keeping track of the large amount of impacts of the next big marine oil spill, wherever it may happen.

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48 How stable are our indices? - differentiating between sources in a weathering environment
S.M. Mudee, NILU - Norwegian Institute for Air Research / IMPACT

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Aarhus University / Department of Biology; J. Fritt-Rasmussen, Aarhus University / Department of Bioscience - Arctic Environment; O. Gjestvang-Hansen, M.R. Larsen, Greenland Institute of Natural Resources; K. Gustavson, Aarhus University / Department of Bioscience - Arctic Environment

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49 Exposure to biphenol S alters microRNA expression in male zebrafish (Danio rerio)
J. Lee, J. Ji, Yongin University

In response to the restriction of biphenol S (BPS), biphenol S (BPS) has been widely used in the manufacturing of polycarbonate plastics and epoxy resins as an alternative compound. BPS has been found to affect reproduction, development,
and immune system. Although microRNAs (miRNAs) play a crucial role in many metabolic activities, whether and how they are involved in the process of BPS-induced toxicity is largely unknown. BPS-induced changes in miRNAs and target gene expression in male zebrafish (Danio rerio) gonad, and the potential mechanism was investigated. Male zebrafish were exposed to 0, 5, and 50 μg/L BPS for 21 d. miRNA was isolated from the gonad pool and the expression profiles of 255 known zebrafish miRNAs were analyzed using Affymetrix microarrays. Quantitative real-time qRT-PCR was used to confirm the role of BPS-induced toxicity via the interference with the aromatization process. The results of this study will provide novel insight into the epigenetic regulatory mechanisms of BPS-induced toxicity in male zebrafish.

50 Zebrafish as a model to investigate mechanisms of adverse metabolic and cardiovascular outcomes associated with elevated dietary selenium exposure D.M. Jang, University of Saskatchewan / Toxicology Centre; C. Petten, University of Saskatchewan - Toxicology Centre / Toxicology; J. Thomas, University of Saskatchewan Toxicology Centre; L.P. Weber, University of Saskatchewan / Veterinary Biomedical Sciences

A variety of physiological activities cause increased loading of the essential trace element selenium into aquatic ecosystems, where it poses an extreme toxicological hazard to fishes due to the narrow range between essentiality and toxicity. Although several studies have reported developmental toxicities in early life stages of fishes, fewer studies have investigated sublethal toxicological effects that may occur following dietary selenium exposure in adult fishes. Adult zebrafish were exposed to dietary selenium (6× the US terrestrial ecological reference (TER) at 25–26°C and 14 h:10 h light cycle) for 21–26 d. mRNA expression levels of several genes involved in metabolism were determined. Compared to controls, adult zebrafish exposed to elevated dietary SeMet exhibited impaired swimming performance (lower fatigue velocity or Ucrit). This was associated with elevated basal metabolic rate and reduced aerobic scope, indicating impaired aerobic capacity. Triglycerides (the primary fuel for aerobic swimming) were elevated in a dose-dependent manner, which was associated with altered transcription abundance of several genes involved in lipid homeostasis. Ultrasonography revealed decreased cardiac output, which was associated with increased echodensity at the atrial-ventricular junction and reduced mRNA expression of the collagenase, MMP2. These results suggest significant ecophysiological effects that may impair the fitness of fishes exposed to elevated dietary Se in contaminated ecosystems. From a comparative biomedical viewpoint, this approach leads to the identification of zebrafish as a model to investigate mechanisms of metabolic, energetic, and cardiovascular toxicities caused by excess dietary Se exposure, since similar responses following selenium over-supplementation have been reported in the human clinical toxicology literature. A proposed adverse outcome pathway (AOP) based on this study will be presented that links changes in gene expression to key events leading to adverse outcomes at the individual, and potentially population, levels of biological organization.

51 Toxicity and neurotoxicity profiling of sediments from Gulf of Bothnia with Danio rerio embryos R. Massig, Helmholtz Centre for Environmental Research / UFZ; H. Holder, RWTH Aachen University / Institute for Environmental Research; M. Krauss, T. Schulze, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; C. Weidauer, Helmholtz Centre for Environmental Research UFZ; P. Haglund, C. Galampois, Umea University; M. Tysklind, Umea University / Department of Chemistry; W. Brack, Helmholtz Centre for Environmental Research UFZ / Dept. Bioanalytical Analysis

Sediments are a well-known sink for a large variety of organic pollutants that may cause distress to benthic and pelagic species in case of their remobilization to the water-phase. Risk assessment of complex mixtures may involve component-based approaches applying chemical analysis together with measured or predicted toxicity data of individual components and mixture risk modeling or whole mixture approaches using in vivo or in vitro assays. Both approaches are combined in both approaches using chemical and bio-analytical tools for characterization for example of sediment contamination is expected to provide a more comprehensive picture of toxic risks to aquatic organisms. One of the most promising organisms for diagnostic in vivo testing of sediment may be zebrafish embryos (Danio rerio) being a versatile in vivo model suitable for high-throughput analysis while keeping several advantages of in vitro approaches (i.e. low-cost, sensitivity, short duration of the test). The fish embryo test (FET) with Danio rerio has been considered as a good surrogate for the acute toxicity fish test and was successfully used in several studies for the detection of toxicity and neurotoxicity in sediments samples. One of the major advantages of the FET with Danio rerio is the possibility to monitor several toxic endpoints including the modification of biochemical and molecular processes, which can be related to the exposure of specific pollutants. The present study provides a first attempt to integrate a diagnostic whole mixture assessment workflow based on in vivo toxicological profiling of Danio rerio after direct exposure to sediments from Gulf of Bothnia (Sweden) for 4 days. The objectives of the present study was to validate a screening approach for sediment of samples (2) to offer a first in vivo toxicological profile of sediment from three different polluted sites from Gulf of Bothnia.

52 Proteomics based screening tool to detect molecular responses following aromatase inhibition S.U. Ayobahnam, IME Fraunhofer / Department of Aquatic Ecotoxicology; E. Eiblreth, M. Teigeler, Fraunhofer IME / Ecotoxicology; M. Kothoff, Fraunhofer IME / Environmental and Food Analysis; S. Kalkhof, University of Applied Sciences Coburg / Department of Bioanalytics; C. Schaefers, Fraunhofer-Institut / Ecotoxicology; H. Hollert, RWTH Aachen University / Institute for Environmental Research

Chemical exposure to endocrine disruptors can have adverse outcomes on organism health and function; however, the current reliance on end-points such as egg number, plasma VTG content and morphological changes to determine effects of endocrine disrupting chemicals has given rise to series of questions related to chemicals exhibiting similar effects but different mode-of-action (MoA). Identification of the putative molecular questions related to MoA has become crucial for analyzing, accessing and determining chemical effects. Proteomics, therefore, show appreciable promise as a molecular screening tool for identifying specific alterations between exposures and controls, which is therefore imperative in discriminating endocrine disruptors from substances with a non-endocrine MoA. Such tool raises the need for elongated higher-tier testing. This study was focused on fadrozole, a known inhibitor of cytochrome P450 aromatase. Thus an excellent model substance to evaluate and validate proteomic methods with the integration of organ-specific effects. Spawning adult zebrafish groups (5 males, 5 females) maintained at 25–26°C and 14 h:10 h light:dark cycle were exposed for 21 days to fadrozole (0, 0.1, 1, 10 μg/L) and analysed for plasma vitellogenin content, egg numbers and organ histopathology. Livers and gonads were isolated for shotgun proteomics and qPCR to characterize substance induced specific molecular toxicity pathways. Proteins involved in steroid hormone secretion and estrogen stimulation such as vtg1, vtg3, vtg6 and lman1, were significantly deregulated. Several of the prominently affected pathways involved regulation of xenobiotic stimuli, lipid metabolism, metabolic processes, TCA metabolism and calcium signalling. Our study demonstrated that the downstream induced-estrogen receptor suppression by aromatase inhibition triggered the downregulation of estrogen synthesis, which was assumed to induce the observed decrease in egg numbers and oocyte atresia with membrane folding in the ovary. We anticipate that this approach leads to the identification of reliable biomarkers to determine chemical-induced adverse outcomes of ecological relevance in order to avoid unnecessary extensive testing.

53 Zebrafish embryos are able to conduct complex biotransformation processes and activation of chemicals E. Küster, Helmholtz Centre for Environmental Research, Dept.Bioanalytical Ecotoxicology / Department Bioanalytical Ecotoxicology; B. Seiwert, Helmholtz Centre for Environmental Research- UFZ / Department Analytical Chemistry; S. Speer, Helmholtz centre for environmental research - UFZ / Dept. Bioanalytical Ecotoxicology; S. Brox, Helmholtz centre for environmental research - UFZ / Department Analytical Chemistry; T. Reemtsma, Helmholtz Centre for Environmental Research / Department Analytical Chemistry; S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology

Zebrafish embryos are proposed and partially already used as replacement for tests with (adult) animals conducted for human and environmental hazard assessment. Until now, it has been a concern that embryos exhibit a limited metabolic activity which could interfere with prediction of adverse effects for safety assessment. The concern was provoked by anecdotal observation of the lack of activation for some compounds leading to a weak acute toxicity in fish embryos. However, internal concentration profiles of parent compounds suggest that fish embryos are principally capable for metabolic transformation of chemicals (Kühnert et al., 2013, Environ. Toxicol. Chem. 32, 1819–1827). In order to assess the biotransformation more systematically we studied the biotransformation of two pharmaceuticals (clofibrate, celecoxib). Overall similar transformation products could be observed in zebrafish embryo as known from human studies. Interestingly, the ratios of the different products in fish embryos seemed to be different from the ratio in humans. Biotransformation is of particular relevance for compounds that require (metabolic) activation to elicit their intended biological effect or where activation “accidently” produces more toxic substances. Organophosphates (OP) can serve as a model compounds for a proof of concept for activation in fish embryos as in many cases activation is mediated by cytochrome P450 oxidation. Therefore, we studied the
activation of organophosphates by comparing the inhibition of acetylcholinesterase (AChE) activity for the parent compound and the oxon-metabolite in homogenates and intact embryos. For homogenates only the oxon metabolites were able to provoke AChE inhibition in a concentration dependent manner. In intact embryos inhibition was also found for the parent compounds. The inhibition EC50 was gradually reduced in later stages of embryos, if 24h exposure intervals for different stages were compared. The findings suggest that fish embryos are principally able to activate organophosphates and potentially also other compounds and that later embryonic stages may exhibit advanced biotransformation capacity.

54 Differing PM2.5 Filter Extraction Methods: Impact on Chemical and Toxicological Analyses
C. Roep, Oregon State University / Department of Environmental and Molecular Toxicology; S. Simonich, Oregon State University / Depts of Chemistry and Environmental Molecular Toxicology; R.L. Tanguay, Oregon State University / Sinhumber Aquatic Research Laboratory and the Environmental Molecular Toxicology

Toxicology research is essential to improve the understanding of the global public health burden of fine particulate matter (PM2.5) exposures. However, research groups use differing filter extraction methods to prepare PM2.5 and the potential toxicity bias from different extraction methods is rarely considered, possibly eliminating inter-laboratory comparisons and misrepresenting the toxic responses to PM2.5 constituents. To determine the impact of filter extraction methods on chemical constituent recovery and toxicity outcomes we took equal portions of a single hi-volume PM2.5 filter sample collected in Riverside, CA. Each filter portion underwent a different extraction method (n=6) and recovered PM2.5 was then prepared for developmental toxicity testing by collecting the soluble fraction from DMSO extraction. Zebrafish (n=32/treatment) were treated with controls (DMSO, blank filter portions) and treatments (PM2.5 filter portions undergoing filter extraction) starting at 6 hours post fertilization. Aliquots of these PM2.5 solutions were used for chemical constituent analysis of polycyclic aromatic hydrocarbons (PAHs, n=120) and elements (n=20). Significant increases in mortality were observed for PM2.5 from 5 of the 6 filter extraction methods when compared to both the DMSO and blank filter controls. Combined mortality and morphological changes were significantly increased following PM2.5 treatment in all extraction methods compared to DMSO controls. Importantly, two of the methods showed significant mortality and morphological changes with blank filters when compared to DMSO controls. Chemical analysis is underway and differences in PM2.5 solutions between extraction methods will be investigated. Correlations between chemical components and developmental toxicity outcomes will identify components that are driving toxicity and potentially altered during specific extraction procedures. This research highlights the toxicity bias due to PM2.5 filter extraction methods that must be considered when conducting research with complex ambient mixtures. Ultimately, this work identifies extraction procedures for use in this cost-effective surrogate to compare the inherent toxicity differences of PM2.5, and provides a path that will ultimately promote improved understanding of PM2.5-associated health effects.

Safeguard and Conservation of Cultural Heritage: the contribution of chemistry

55 Cultural Heritage and Climate Change: impact and adaptation
C. Sabboni, CNR-Istituto di Scienze dell’Atmosfera e del Clima

Cultural heritage, which is a non-renewable resource, is a sector extremely complex for the diversity of materials, structures and systems. The access to citizens and visitors need to be favoured, but at the same time, it is our responsibility to transmit this heritage we received from the past to the future generations. It is urgent to include cultural heritage in the value chain of sustainable development: the priority that faces the world today. Research on the threats that climate change will have on cultural heritage has been very limited until now and it has not yet generated policies designed to mitigate the impact and to develop preventive adaptation strategies. The presentation will be focused on future scenario on the effects of climate variables on the vulnerabilties of cultural heritage. The presentation will be focused on future scenario on the effects of climate variables on the vulnerabilties of cultural heritage. The presentation will be focused on future scenario on the effects of climate variables on the vulnerabilties of cultural heritage.

56 Nutraceuticals for the conservation and connected risks
M.J. Mosquera, University of Cadiz

Most products commonly employed in the restoration and conservation of cultural heritage materials have not been specifically developed to preserve such elements. In addition, they are plagued by limited performance and structural drawbacks such as low adhesion, poor penetration, and cracking. Another disadvantage is the requirement for most products to be dissolved in volatile organic compounds (VOCs), which produce environmental and human health risks in their use. In this lecture, I will review the most meaningful achievements of my group in this field. We have developed an innovative sol-gel route for preserving Cultural Heritage building materials. Specifically, a surfactant-assisted sol-gel synthesis to produce, in-situ on the building, crack-free nanomaterials to be used as long-term consolidants. Additionally, hydrophobic, water-repellent, self-cleaning, and biocidal properties can be incorporated into the product by innovative chemical modifications of the proposed synthesis route. Finally, I will summarize the future challengers of our group related to conservation of historic concrete in the framework of the Horizon 2020 project “InnovAcConcrete”.

57 Towards the European Research Infrastructure in Heritage Science: E-RIHIS
L. Pezzati, CNR-Istituto Nazionale di Ottica

The European Research Infrastructure for Heritage Science (E-RIHIS) entered the European strategic roadmapping PM (Pathway) roadmap in 2016, as one of the six new projects. E-RIHIS support research on heritage interpretation, preservation, documentation and management. Both cultural and natural heritage are addressed: collections, buildings, archaeological sites, digital and intangible heritage. E-RIHIS is a distributed research infrastructure with a multi-level star-structure: facilities from many Countries will be organized in national networks, coordinated by several nodes. National hubs and regional hubs will provide the unique access point to all E-RIHIS services, by coordinating the network of Hub.

58 Discussion & Conclusions

Modelling and monitoring of pesticides fate and exposure in a regulatory context (II)

59 Scenario Development for Off-field Soil Exposure and Risk Assessment
M. Wang, WSC Scientific GmbH / Dept Eftea Modelling; J. Kleinmann, WSC Scientific GmbH; T. Schad, Bayer AG / Environmental Modelling; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; G. Ernst, Bayer AG / Ecotoxicology; G. Goerttler, Bayer CropScience AG / Environmental Safety; P. Neumann, Buyer Ag; S. Bub, Tier3 Solutions GmbH

In its Scientific Opinion on risk assessment for in-soil organisms EFSA proposes a preliminary approach for off-field soil exposure by adding up entries from the different major exposure routes. EFSA finds the worst-case character of its scenario “In the absence of appropriate off-field exposure scenarios...”, and hence, emphasises the necessity for model and scenario development. The present work aims to undertake first steps (i) to develop a model approach for off-field/off-crop soil exposure due to runoff, erosion, and drift, (ii) to develop exemplary schematic and real-world scenarios, (iii) which allow to gain insights in off-field soil exposure and risk using case studies. The developments are based on the Specific Protection Goals options. A tiered modelling approach is presented which allows to build exposure scenarios ranging from simple schematic and conservative to more realistic landscape-scale tiers, which can be easily linked to effect modelling (toxicological, population, community). Results are intended to support the design of off-field soil exposure and risk characterisation scenarios and the development of assessment endpoints relevant to specific crops.

60 Biogenic residues formation from pesticides - an overview
K. Nowak, TU Berlin / Institute for Environmental Research (Biologie V); A. Miltner, Helmholtz Centre for Environmental Research UFZ / Department of Environmental Biotechnology; M. Kästner, Helmholtz centre for environmental research - UFZ / Department of Environmental Biotechnology

Anthropogenic organic chemicals are deliberately (e.g. pesticides) released in the environment as complex matrices provide a wide variety of binding sites and are the major sinks for these compounds. Pesticides entering these complex systems may undergo various turnover processes. They can be degraded chemically (e.g. photolysis), biologically by microorganisms (e.g. volatilisation leached to the groundwater or taken up by living organisms or immobilised in the form of non-extractable residues (NER). Microorganisms can use C and N from a pesticide to synthesize their biomass, e.g. amino acids (AA) and fatty acids (FA). The extraction of known microbial biomarkers from soil or sediment after addition of C and N isolate tracer allows an estimation of microbial activity in the transformation of pesticide. We investigate the turnover of typical pesticides (2,4-D, glyphosate, metribuzin, bensulfuron, bromoxynil and clodinafop-propargyl) with the particular focus on the metabolic incorporation of the isotope label into AA, FA and their fate over time. An agricultural soil and water-sediment were incubated with stable isotope labelled respective herbicide in the dark and at constant temperature (20°C). Soil and sediment samples at the respective sampling date were analysed for the amount and isotopic composition of AA, FA, CO2, solvent-extractable parent compound and metabolites and total NER. The presented data indicated that easily biodegradable herbicides e.g. glyphosate, 2,4-D or metribuzin were utilized as a carbon (and
nitrogen) source and the NER were mainly biogenic. The major formation of biogenic residues is supposed to be relevant for easily biodegradable contaminants under significant CO₂ formation. However, in the case of more recalcitrant pesticides like bentazone, the incorporation of C into microbial biomass, although reported to be very low, cannot be completely excluded.

61 Derivation of a foliar wash-off factor for FOCUS modelling based on literature research
S. Sittig, Dr. KNOELL CONSULT GmbH; E. Fate Modelling; C. Wellmann, Dr. Knoell Consult GmbH; G. Reiniken, Bayer AG, Research & Development, Crop Science / Environmental Safety
After foliar application, plant protection products (PPP) undergo several routes of dissipation of which one is precipitation-induced wash-off from the canopy. This process is accounted for in the European exposure assessment framework for PPP authorization and included in the corresponding numerical models, e.g. FOCUS PEARL, PELO, PRZM and MACRO. A numerical wash-off factor for modelling is applied, quantifying the wash-off from plant surfaces by a given amount of precipitation. Consequently, this factor is relevant for the calculation of predicted environmental concentrations (PEC) for the compartments soil, groundwater, and surface water. In case a measured wash-off factor is not available, a default value is to be applied. An increase of this default value from 0.5 cm⁻¹ to 1 cm⁻¹ has been proposed by EFSFA, which results in more exhaustive wash-off from the plant surface. Generally, the extent of rainfall-induced displaced substance depends on several factors. An ECPA working group recommended a harmonized experimental approach to derive wash-off factors in the greenhouse: a 24 h time interval between pesticide spraying and 10 to 20 mm of artificial rain, followed by an extraction of the plant material with an acetonitril/water mixture of 80:20 (v/v). This standardized experimental procedure has been defined in order to derive a reliable numerical wash-off factor as input for FOCUS modelling. In this study, the published literature was reviewed for the availability of data suited for the calculation of the wash-off factor, reflecting a variety of different investigation types in terms of time of (artificial) rainfall after application, rainfall amount and intensity, formulation, crops under investigation, etc. Published experimental wash-off studies are usually not conducted according to the standardized experimental procedures. Thus, only a limited number of the published studies are suitable to derive a wash-off factor for modelling. The outcome of the literature review presented herein suggests that a meaningful default wash-off factor should be well below 1 cm⁻¹. Keeping the existing default value of 0.5 cm⁻¹ retains a sufficient protection level while at the same time avoids a large number of unnecessary refinement studies.

62 Application of a dynamic aquatic food web model for FOCUS exposure assessment
L. Padilla, Stone Environmental, Inc.; A. Del Signore, D. Sprenger, L. Weltje, BASF SE / Crop Protection Ecotoxicology; M.F. Winchell, Stone Environmental, Inc., BASF SE
In a regulatory setting, the potential for bioaccumulation and biomagnification of plant protection product active substances in aquatic organisms is evaluated with simple screens on the basis of a substance’s log Kow, where typically a value greater than or equal to 3 indicates concern. However, this criterion may lead to false positive identification, because it does not account for biotransformation of the chemical in the organism or biowrackage in the environment. Dynamic aquatic food web models are more refined tools for determining bioaccumulation and biomagnification potential, because they can account for chemical bioavailability and temporal and spatial variability in exposure concentrations due to seasonal and regional differences in weather and agricultural practices. The aim of this work is to demonstrate a modelling approach that couples standard FOCUS landscape and water body models with a dynamic aquatic food web model to assess whether a hydrophobic insecticide with log Kow above the screening threshold of 3 will bioaccumulate/biomagnify. The Simon Fraser University (SFU) aquatic food web model, which predicts chemical concentrations in biota at six different trophic levels within an aquatic ecosystem, was selected based on the availability of data for relatively few input parameters and its demonstrated capability to predict observed chemical concentrations for a wide range of species, chemicals, and aquatic environments. To maximize relevance for agricultural systems in Europe, the food web model was adapted to accept environmental concentration time series input from the established TOXSWA model used in EU pesticide registration procedures. The modelling approach leveraged the transient form of the aquatic food web model for time-varying time series data to model the dynamic and spatio-temporal specifics of agricultural settings. Modelling results included both the daily time series predictions of organism concentrations for the six trophic levels and the uptake and elimination rate constants calculated from organism sub-models. In total, nine FOCUS scenarios were simulated and compared (five drainage scenarios with MACRO and four runoff scenarios with PRZM) and dominant organism uptake pathways were identified. The approach may be used to refine log (Kow)-based screening bioaccumulation and biomagnification evaluations for regulatory purposes.

63 Improved assessment of pesticide peak exposure in cultivated mountain watersheds
M. Morselli, University of Insubria / Department of Science and High Technology; E. Terzaghi, University of Insubria (Como); Department of Science and High Technology, Como; A. Di Guardo, University of Insubria / Department of Science and High Technology
Agricultural activities can involve the use of plant protection products (PPPs) and the use of such chemicals can occur near surface waters bodies, thus creating a potential for adverse effects on aquatic ecosystems. Due to the spatio-temporal variability of chemical applications and of the processes regulating their fate and transport to surface waters, ecosystems are often exposed to pulses of contaminants. In recent years environmental scenarios, such as small mountain watersheds, where runoff fluxes are particularly rapid due to side slopes, exposure peaks can be shorter but much higher. Monitoring campaigns are often inadequate or too expensive to be carried out and modelling tools are therefore vital for exposure assessment and their use is encouraged by current legislation. However, currently adopted models and scenarios (e.g., FOCUS for PPPs) are often too conservative and/or “static” to accurately capture exposure variability, and the need for more realistic and dynamic tools is now one of the major challenges for risk assessment. In a previous work, the new fate model DynAPlus was developed to improve pesticide fate predictions in cultivated mountain basins. The model was successfully evaluated against chlorpyrifos water concentrations measured in the Novella River (Non Valley, Northern Italy), where more than 1000 ha of apple orchards surround the river and Institute of Bioeconomy Research; P. Horney, Julius Kühn Institut; D. Daehmlow, Julius Kühn-Institute / Institute for Strategies and Technology Assessment; B. Goll, Julius Kühn Institute / Institute for Strategies and Technology Assessment; J. Strassemeyer, ral Research Centre for Cultivated Plants / Institute for Strategies and Technology Assessment
In response to the implementation of the EU-directive on sustainable pesticide use (2009/128/EC), the project SMARTCROP (funded by the Research Council of Norway), was started to address the challenges of developing and providing farmers with the necessary IPM tools. Towards this objective, SYNOPS, a risk indicator developed by the Julius-Kühn Institut, Germany, was adapted for Norway and provided with a graphical user interface such that a farmer or non-expert could perform risk assessments for field-specific pesticide applications. US-EPA PRZMS and VFSM0D have been incorporated in SYNOPS for a more realistic modelling of the runoff/erosion modules and the functioning of the vegetated filter strip. The Norwegian tool, SYNOPS-WEB, Norway, is available in both English and Norwegian. It uses Norwegian land-use, surface water and soil data, plant protection products registered for use in Norway, modified crop data for Norwegian conditions, and station-based climate and runoff data. Data are used to derive runoff coefficients for specific field and application scenarios. Another important new feature is the implementation of various mitigation measures such as vegetated filter strips, hedges, tile/valle, and cover crops. Risk assessments can be performed for a combination of mitigation measures in order to select the optimal application strategy under specific field conditions. In this presentation, we describe and discuss the mitigation measures implemented in SYNOPS-WEB, Norway, and the corresponding adjustments to the model input parameters. We provide example scenarios based on realistic application patterns, without and with mitigation measures. Aquatic and terrestrial risk indices are presented to the user as Exposure Toxicity Ratios (ETR) in the form of colour-coded tables for an easy visual appraisal of the environmental risk under different conditions. In addition the predicted environmental concentrations can be viewed on a daily basis for the selected time period.

Hydrophobic Chemicals and Mixtures: Reliable Investigations
on their Environmental Fate and Effects (II)

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Acute Toxicity of Pyrene Associated with Dissolved Organic Matter of Various Molecular Weights to Daphnia magna

H. Li, X. Xia, S. Bi, X. Jiang, H. Wang, W. Wen, School of Environment, Beijing Normal University

Dissolved organic matter (DOM) is a key environmental factor for the toxicity of hydrophobic organic compounds (HOCs) in natural waters. However, the toxicity of DOM-associated HOCs is still not clear. In this research, pyrene was selected as a model HOC and its dissolved component (C_{DOM}) was mimicked by passive dosing systems. The immobilization and enzymatic activities of Daphnia magna were examined to analyze the toxicity of DOM-associated pyrene. The results indicated that the immobilization of Daphnia magna in the systems containing various molecular weight DOM and pyrene was ordered as middle molecular weight (MMW, 5-10kDa) DOM > higher molecular weight (HMW, > 10kDa) DOM > 0.5-1kDa DOM > < 0.5kDa DOM. Furthermore, the superoxide dismutase (SOD), catalase (CAT), and peroxidase (POD) activity of Daphnia magna decreased gradually with the increasing C_{DOM} in the systems of MMW and HMW DOM, whereas increased when C_{DOM} was at a low level and then decreased when C_{DOM} was at a higher level in the control group with pyrene only and the system of LMW DOM. The influencing dosing from a silicone rod has successfully been used in biodegradation and toxicity testing of DOM-associated pyrene to Daphnia magna were related with the amount of pyrene sorbed on DOM, the uptake routes of DOM by Daphnia magna, and the desorption of pyrene from DOM in the gut of Daphnia magna. The findings obtained in this research suggest that the toxicity of DOM-associated HOCs should be taken into account for the eco-environmental risk assessment of HOCs in water systems.

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Passive dosing for constant concentration and defined composition of hydrophobic organic mixtures

R. Hammershøj, Technical University of Denmark / Department of Environmental Engineering; H. Birch, DTU Environment / Department of Environmental Engineering; K. Knudsmark Sjøholm, University of Copenhagen / Dept. of Plant and Environmental Sciences; P. Mayer, Technical University of Denmark / Department of Environmental Engineering

There is regulatory and scientific attention on the fate, exposure and effects of chemical mixtures including complex mixtures of hydrophobic chemicals such as petroleum substances and essential oils. These mixtures have recently been categorized as multicomponent substances and substances of unknown or variable composition, complex reaction products or biological materials (UCBVs). The dosing of such mixtures in environmental experiments and tests can be challenging and there is an urgent need for new methods to provide stable concentrations and defined composition of these mixtures in aquatic fate and toxicity testing. Passive dosing from a silicone rod has successfully been used in biodegradation and toxicity testing of hydrophobic chemicals covering a broad chemical space in terms of K_{oc} and K_{ow}. This study aims to extend the applicability of the novel passive dosing method to hydrophobic multicomponent substances and UCBVs (i.e. complex mixtures). The method is straightforward: a silicone rod is loaded by direct addition of the mixture and subsequently equilibrated with ultrapure water to create constant and defined concentrations of each mixture constituent and thus also a constant and defined mixture composition. The aqueous concentration level can be controlled by the amount of mixture added to the rod. Early results show a good performance of the method with very fast dosing kinetics, aqueous concentrations increasing linearly with loading level and good reproducibility of the passive dosing for a petroleum substance and an essential oil. The presentation will focus on 1) the fast and reproducible loading of selected UCBV mixtures, 2) reproducibility and optimized passive dosing kinetics for one petroleum substance and one essential oil and 3) the performance and characteristics of the passive dosing method compared with more traditional dosing methods.

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Biodegradation of volatile substances in soil - Challenges and optimization of test setups (OECD 307)


Higher tier biodegradation laboratory tests in soil, sediment and/or surface water systems are conducted using standard OECD guidelines. As stated in these guidelines, they are not suitable for testing volatile chemicals, however a threshold based on Henry’s law is not defined, except in OECD 909. In the actual setups, incomplete mass balance is a major problem while testing volatile chemicals. Optionally, OECD 307 and 308 allow biometer-type incubation setups but it does not require any data to prove if the systems remains aerobic. In addition, the degradation kinetics in a closed test system can largely be influenced by air-water partitioning as described by Birch et al. 2017. Our objective was to design a closed incubation test set up where maintaining and measuring of aerobic conditions was possible without the loss of test chemical. Additionally, a full scale OECD 307 with two model chemicals was performed to check the reproducibility of data in terms of mass balance and to better understand the obtained degradation data. The test setup consisted of 100 ml flask with 50g soil, CO₂-trap and a Tenax tube completely closed using a stainless steel lock system. Oxygen saturation in the headspace was measured in a reference sample using optical measurements without the need to open the vessel. If the oxygen saturation was < 15%, the samples was aerated with oxygen-rich air. Applying this setup, degradation of 14C-labelled Tetralin and Decane was conducted on systems with different texture, organic carbon and microbial activity. At sampling dates the headspace air of the samples was stripped off through the Tenax tube using a vacuum pump. The Tenax tube and the CO₂-trap were taken for analysis and the soil was taken for extraction using appropriate methods. The solid extraction residue was subject to combustion analysis to determine the non-extractable residues (NER). The average overall recovery of 99.29% (N=90) for Decane and 104.34% (N=90) for Tetralin with a variation (between the individual replicates) < 11% for both studies suggests that obtaining a complete mass balance with the new test setup was reproducible. It was observed that radioactivity adsorbed on Tenax (100% parent), was higher in the soils with lower OC content suggesting that sorption of the chemical affecting its volatilization and hence degradation. Thus, how to deal with the volatilized parent fraction while calculating degradation kinetics is still a part of ongoing research.

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Untangling the biodegradation of hydrophobic chemicals in OECD and novel tests using a unified modelling approach

F. Pollet, Technical University of Denmark (DTU) / DTU Environment; A. Borregaard, DTU Environment; F. Sibany, K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Kästner, Helmholz centre for environmental research - UFZ / Department of Environmental Biotechnology; S. Trapp, Technical University of Denmark. DTU / DTU Environment

Persistence assessment using standardized (e.g., OECD) tests is one of the main challenges for hydrophobic organic compounds (HOCs). While the use of radiolabeled chemicals brought major advances, mechanistic models can still provide deeper insights in experimental results and underlying processes. In this context, the key objective of this study was to test the applicability of a unified model approach across two of the most used OECD degradation tests with a newly developed experimental tests for HOCs. We specifically aimed at (i) elucidating biodegradation kinetics and improving their estimation by including a new method for microbial yield calculation; (ii) determining 14C fractions (mineralized, incorporated in biomass and non-extractable residue NER) at the end of tests as persistence indicators. The unified model for sorption and biodegradation (in combination with the Microbial Turnover to Biomass growth yield estimation method) was used to predict mineralization to CO₂ growth of degrading microorganisms and NER formation in aerobic degradation tests with selected 14C-labeled HOCs (triclosan, pentachlorophenol—PCP, propargite and pyriproxyfen). Model predictions were fit to experimental results obtained elsewhere in conventional degradation tests activated sludge or soil or in novel passive dosing setups, in order to extend the range of applications. Good agreement between model predictions and empirical data was shown by adjusting only the ratio v_{max} / K_{m}, which describes biodegradation kinetics according to the Michaelis Menten equation. Overall, a high range of v_{max} / K_{m} values was shown for the selected substances (0—55 mg l⁻¹ d⁻¹), indicating that both limited bioavailability and intrinsic recalcitrance can explain HOC persistence. This study represents a first attempt of using a unified modelling approach for predicting biodegradation of HOCs across a variety of tests, showing promising results towards persistence prediction of organic chemicals during regulatory screening. Ongoing research is focusing on extending the model applicability by (i) including the formation of intermediate transformation products; (ii) determining (de)sorption limitation based on dedicated experiments; and (iii) using uncertainty-based approaches to support decision makers within REACH.

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History of polychlorinated biphenyl deposition to snow and ice from the Lomonosovfonna glacier, Svalbard

M. Groneng, Hermann & Associates LLC / Environmental Chemistry; O. Garmash, University of Helsinki; E. Jakobsen, Norwegian Polar Institute; C. Teixeira, D.C. Muir, Environment and Climate Change Canada / Aquatic Contaminants Research Division

Polychlorinated biphenyl (PCB) deposition to the north polar regions has long been recognized. Here we investigate quantitative and qualitative PCB inputs to the Lomonosovfonna glacier on Svalbard from an ice core drilled in 2009, and a snow pit from spring 2010. Lomonosovfonna is the highest-elevation ice on Svalbard at 1250 masl. It is above the tropospheric boundary layer at all times of year (maximum ~1000 masl), so all of the contaminant inputs have sources from long
distances, and do not include any local PCB sources on Svallbard. Total PCB deposition history to the core and surface snow shows that amounts have not declined in net amount since the mid 1950s. The peak flux in the surface snow and to ice core layer is 18.5 - 19 pg cm^-2 yr^-1. Average 5-day air mass back trajectories from peak flux periods beginning in 1998 show more frequent 5-day air mass trajectories from Russia, and from Europe south of 600 N latitude, particularly extending into the U. K., relative to 1899-1998, which had 5-day trajectories ending in the far north of Russia and Norway. The surface snow PCB congener profile is dominated by PCB 110, 70,74, 101, 95, 11. Combined, these five congeners represent ~27% of PCB. The uppermost ice core sample is dominated by PCB 95, 52, 101, 110, 70,74, which represent ~42% of PCB. The most apparent difference between the two profiles is the lower amount of dichloro- and trichloro- congeners in the marine samples (Figure 1B). The indication is that the most volatile congeners in the dichloro- and trichloro- homologues are deposited to surface snow shown in Figure 1A, but are volatilized back to the atmosphere during periods of higher summer air temperature. The percent of PCB-111 through the samples ranges from 0.90-3.4% and is present in all samples dating from 1957. It is the dominant congener among chloro- and di-chloro PCBs. This PCB congener has very low or no presence in Aroclor products, and apparently is not found in other PCB parent mixtures. Its source is often considered to dairylide yellow pigment or products containing it. Its presence in the environment is sometimes associated with disposal of products containing this pigment. The source of PCB-11 to Lomonosovfonna is uncertain, but could be waste incineration facilities in Europe where it has been found in flue gas.

70 Environmental occurrence and distribution of organic UV stabilizers in the sediment of the Bohai and Yellow Seas

C. Apel, Helmholtz-Zentrum Geesthacht; J. Tang, Yantai Institute of Coastal Zone Research, CAS; R. Ebinghaus, Helmholtz-Zentrum Geesthacht / Department for Environmental Chemistry, Helmholtz-Zentrum Geesthacht

Organic UV stabilizers are of emerging environmental concern due to their large production volumes and potential endocrine disrupting properties. UV stabilizers are widely used in plastic products, paints and coatings to improve the product stability against UV light. Furthermore, some UV stabilizers are approved as ingredients in personal care products like cosmetics and sunscreens. The pathways into the marine environment are either indirect by wastewater treatment plant discharges or indirect by recreational activities like bathing and swimming. Four benzotriazole UV stabilizers are classified as SVHC (Substances of Very High Concern) under the EU legislation REACH. Numerous others are currently listed under the European community rolling action plan (CoRAP) to be (re)-evaluated in the next years. Due to their chemical properties, most UV stabilizers accumulate in sediment (logKow > 3) and have potential for persistence or pseudo-pERSISTENCE.

Environmental data for the coastal and marine environment are sparse. For this study 74 surface sediment samples of the Bohai and Yellow Seas were analysed for 19 commonly used organic UV stabilizers. The sample pretreatment and analysis was carried out as follows: First, the samples were homogenized with sodium sulphate. Afterwards, extraction and clean-up was performed using an accelerated solvent extraction (ASE-350, Dionex, Germany) method. For this, 22 mL stainless steel ASE cells were filled with 3 g of 10% deactivated silica and approximately 5 g sediment that was spiked with appropriate isotopically labelled n-Octane (90% 13C). Extraction was performed on a LC-MS/MS system (Agilent Technologies, Germany) equipped with an APPI-source and a C18 column (Eclipse Plus RRHD 1.8 µm, 2.1 x 150 mm, Agilent Technologies, Germany). This study shows levels of contamination and distribution of organic UV stabilizers in surface sediments of the Bohai and Yellow Seas for the first time. 14 substances have been positively detected in concentrations in the low ng/g dw range. Characteristic pollution profiles and distribution pattern have been identified, which indicate to different indirect sources of UV stabilizers into the study area.

LCA method developments in a global perspective: Status and outlook (l)

1. Implications of spatial differentiation on LCA-based decision-making: a case study of biochar systems in Indonesia

M. Owasiak, Technical University of Denmark; G. Cornelissen, S. Hale, Northern Geotechnical Institute; H. Lindhjem, Monen Economics; M. Sparrvik, NTNU

The development of spatially differentiated life cycle impact assessment (LCA) methods and their use in regionalized life cycle assessment (LCA) has intensified in the past few years. However, it is less investigated whether spatial differentiation leads to more correct decisions based on the LCA, in addition to just more accurate and realistic LCA results. This analysis was performed on a LC-MS/MS system (1290 Infinity coupled to 6490 triple quadrupole LC/MS, Agilent Technologies, Germany) with an APPI-source and a C18 column (Eclipse Plus RRHD 1.8 µm, 2.1 x 150 mm, Agilent Technologies, Germany). This study shows levels of contamination and distribution of organic UV stabilizers in surface sediments of the Bohai and Yellow Seas for the first time. 14 substances have been positively detected in concentrations in the low ng/g dw range. Characteristic pollution profiles and distribution pattern have been identified, which indicate to different indirect sources of UV stabilizers into the study area.

Indonesia was used as case study. Comparisons were made between 4 villages, 3 biochar production techniques, and 2 fertilization strategies. Results showed that (i) regionalized impact scores for individual impact categories either increased or decreased compared with site-generic scores, depending on the impact category (by up to 1 order of magnitude); (ii) total damages to human health were approximately 3 to 5 times higher when compared to site-generic scores and (iv) irrespective of the geographic locations, regionalized impact scores were generally lower than site-specific scores. This is primarily because of trade-offs between categories, where increase in impact scores for some categories was compensated by decrease in others. Overall, irrespective of the approach to spatial differentiation in LCA, biochar production and use in agriculture is generally expected to bring environmental benefits. When parameter and inventory uncertainties were considered, there was no indication of material differentiation. Therefore, the use of best performing villages in terms of total damage to human health and ecosystems, although village performing worst with regard to total damage to human health changed. There was a general tendency that biochar production using both Kno Tiki and Adam retort kilns performed better than earth-mound kiln, and furthermore biochars brought largest benefits where no-biochar agricultural production systems were based on inorganic fertilizers. This rather consistent ranking was mainly due to relatively large geographic differences in life cycle inventories between villages, which were often larger than geographic differences in characterization factors between site-specific and site-generic approaches. Thus, although spatial differentiation improved accuracy and realism of environmental impacts in this comparative case study, it did not necessarily contribute to more correct decisions.

72 Considering space debris related impacts within the LCA framework

T. Maury, University of Bordeaux / ISM-CyVi; P. Loubet, CyVi-ISM / ISM CyVi; A. Gallice, ArianeGroup / Design for Environment; G. Sonnemann, University of Bordeaux / ISM CyVi

The space sector is a new area of development for LCA studies. The European Space Agency (ESA) has been working since 2012 on environmental issues for space activities through its Clean Space Initiative. ArianeGroup, which is the prime contractor for the development of the new Ariane 6, is currently performing an LCA of this launcher in exploitation phase (ESA’s contractual requirement). However, the current studies adopt a Cradle-to-Launch pad approach due to lack of relevant modelling for use and disposal phase. In addition, a rising sustainability concern is occurring in the space sector particularly regarding impact of space debris: 29,000 human-made objects, larger than 10cm, are orbiting the Earth but only 6% are operational spacecraft, being today a significant and constant danger for all space missions. Consequently, considering end-of-life management during the design of space missions becomes a crucial requirement to reduce environmental impact.

Given this situation, there is an opportunity to make the link between space debris concern and eco-design of spacecraft (satellites & launchers) using the LCA methodology. A focus should be put on the comparison of several missions & post-dismission scenarios to study potential trade-offs between typical impact categories (e.g. toxicity and climate change), but also with regard to the growing issue of space debris. Hence, our challenge is to integrate, via a dedicated additional indicator, space debris related impacts within the LCA to broaden the scope of LCA for space systems. The Area-of-Protection Resources has been identified to reflect the depletion of available orbits by the potential generation of space debris. Considering generation of debris in operating orbits with a resource depletion perspective allows us to address the environmental footprint of the spacecraft’s lifetime. Volume occupied by debris and dead space leads to a decrease of the orbital resource availability enhancing the risk of collision/break-up and then propagation of new clouds of debris. As a consequence, the lack of access to the orbital resource in the future (scarcity) could be handled as environmental and socio-economic impacts. The presentation will prove the relevancy of this approach by presenting the impact pathway linking the occupation of operational orbits and environmental impacts. Environmental mechanisms and impacts (midpoints) will be exposed with associated specific characterization factors.

73 Implementing ozone formation effects due to poplar plantations for biomass production in Europe as impact assessment

P. Vercoulen, Radboud University; R. Kranenburg, C. Hendriks, TNO; R. Van Zelm, Radboud University / Department of Environmental Science

Poplar trees are known to emit volatile organic compounds, among them isoprene, which enhances tropospheric ozone formation. Ozone exposure, in turn, causes adverse effects to human health and ecosystems. In the context of an energy transition, it has been proposed to use poplar biomass for the production of bioenergy. This study builds on the hypothesis that the tropospheric ozone formation effects occurring in the space sector particularly regarding impact of space debris: 29,000 human-made objects, larger than 10cm, are orbiting the Earth but only 6% are operational spacecraft, being today a significant and constant danger for all space missions. Consequently, considering end-of-life management during the design of space missions becomes a crucial requirement to reduce environmental impact.

Considering generation of debris in operating orbits with a resource depletion perspective allows us to address the environmental footprint of the spacecraft’s lifetime. Volume occupied by debris and dead space leads to a decrease of the orbital resource availability enhancing the risk of collision/break-up and then propagation of new clouds of debris. As a consequence, the lack of access to the orbital resource in the future (scarcity) could be handled as environmental and socio-economic impacts. The presentation will prove the relevancy of this approach by presenting the impact pathway linking the occupation of operational orbits and environmental impacts. Environmental mechanisms and impacts (midpoints) will be exposed with associated specific characterization factors.

SETAC Europe 28th Annual Meeting Abstract Book
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (II)

77 Review on removal and reactions of micropollutants in biofilms under growth and non-growth conditions

K. Bester, Aarhus University / Environmental Science; M. Escolà Casas, Aarhus University / Department of Environmental Sciences; U. Bollmann, Aarhus University / Environmental Science; P. Carvalho, Aarhus University, Department of Environmental Science / Department of Environmental Science; E. Toresi, Kruger A/S; H. EI-talawy, Aarhus University / Department of Environmental Science; L. Zhang, Aarhus University / Department of Bioscience; G. Ooi, K. Tang, DTU Environment; H.R. Andersen, Technical University of Denmark / Department of Environmental Engineering; M. Christensen, Anox Kaldnes Pharmaceuticals and other compounds need to be removed from wastewater. This contribution will give an overview on the possibilities of removing micropollutants with biofilms. Biofilms occur in nature, but are also increasingly used in technical installations to remove micropollutants from water (wastewater and drinking water), porous media biofilm systems (sandfilters), moving bed biofilm systems (MBBRs). Biofilms can remove considerably better than suspended bacteria: diclofenac is recalcitrant in sludge systems, while it can be degraded with half-lives of 4 - 5 h in biofilm systems. In this contribution it is highlighted which ecological conditions (aerated versus denitrifying; high and low BOD loads) have been found to favor degradation. It was found that BOD supply has massive impact on the removal: On the one hand high BOD loads led to enhanced growth of biofilm, resulting in high turnover and reaction rates also of the respective micropollutants. On the other hand the biomass related reaction rate constants are considerably higher with lower BOD loads. The highest reaction rate constants and biomass related reaction rate constants were found for systems with intermittent BOD loading. The switch from aerated to denitrifying conditions, however only gives effects for a chosen few compounds like ibuprofen, while reaction rates usually are similar. So the redox conditions as such are obviously not critical. Biofilms have often proven to have unique degradation pathways leading to hitherto strange metabolites. On the other hand compounds that are thought to be recalcitrant (like diclofenac) could easily be degraded in relatively short time periods. For single compounds degradation pathways for biofilm systems are discussed and compared to other systems. – While oxidation pathways are relatively common it seems like biofilms often perform a combination of oxidation and sulfatation pathways. Interestingly enough, it was possible to reach high removal rates for otherwise persistent ozonation-by-products such as macrolide N-oxides while avoiding back reactions to the parents with a moving bed biofilm reactor (MBBR). This also holds for most of the ozonation products of diclofenac.

78 Biodegradation of emerging organic contaminants using an enzyme-mediator system and study of the resulting transformation products

I. Caraen, Curtin University / chemical department; C. Joll, Curtin University / chemical department; K. Linge, Y. Gruchlik, Curtin University; A. Paparini, Murdoch University

Due to improvements in analytical screening methods, a large number of emerging organic contaminants (pharmaceutically active compounds, personal care products, pesticides, surfactants, plasticizers, corrosion inhibitors, flame retardants, artificial sweeteners and others) have been identified in the aquatic environment. Biodegradation is one of the processes that can remove potentially hazardous emerging organic contaminants from different environments, with the help of microorganisms (e.g. algae, bacteria or fungi) and their extracellular products, in both aerobic and anaerobic conditions. The objective of this study was to investigate the biodegradation of a series of antibiotics and one antiviral compound using laccase enzyme, extracted from a white-rot fungi Trametes Versicolor, in the presence of 2,2’-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS), as a mediator. The experiments were conducted in MilliQ water at different pH values, with different ratios of laccase and mediator, under aerobic and static conditions. The degradation was monitored by measuring the concentration of the remaining antibiotic over 168 hours, using a high performance liquid chromatograph with UV detection. The formation of new peaks was also monitored.
and high resolution mass spectrometry (HRMS, LTQ Orbitrap) was used to identify potential transformation products. Furthermore, the microbial activity of the antibiotics and their transformation products was assessed, using an *E. coli* culture and microbial disks. Results showed that 89% degradation of sulfamethoxazole can be achieved at pH=5, with an enzyme activity ranging between 110-120 U/L and an initial mediator concentration of 200 µM, while trimethoprim only degraded by 43% under the same conditions. The results of similar radiation experiments on other antibiotics will be discussed in this conference presentation.

The identification of transformation products of the antibiotics using high resolution mass spectrometry, and the microbial activity of the transformation products, will also be presented. This study provides a better understanding of the biodegradation of emerging organic contaminants and their transformation products. Further work will be focusing on assessing the possible health and environmental risks associated with the reuse of treated wastewater, for applications such as irrigation and groundwater replenishment.

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**Evaluation of macrolide antibiotic transformation in model biodegradation and ozonation experiments using target and non-target analyses and ecotoxicological bioassays**

S. Terzic, Rudjer Boskovsk Institute / Division for Marine and Environmental Research; P. Kostanjevecki, I. Krizman-Matacic, L. Senta, Rudjer Boskovsk Institute; T. Jurina, Faculty for Food Technology and Biotechnology; N. Udikovic-Kolic, Rudjer Boskovsk Institute; J. Cuko, Faculty of Food Technology and ERY TPs; M. Matotic, Faculty for Food Technology and Biotechnology; J. Loncar, I. Mihaljevic, T. Smital, Rudjer Boskovsk Institute; M. Ahel, Rudjer Boskovsk Institute / Division for Marine and Environmental Research

The aim of the present study was to investigate the transformation of three prominent representatives of macrolide antibiotics (azithromycin - AZI, clarithromycin - CLA and erythromycin - ERY) in model biodegradation and ozonation experiments. The study included determination of the toxicity of the parent compounds, identification of transformation products and ecotoxicological evaluation of transformation processes using two different end-points. The biodegradation efficiency was studied using the sludge culture enriched in the presence of AZI (10 mg/L) over a period of 4 months while the ozonation experiments were performed in different matrices by applying selected pH conditions and ozone concentrations. The dissipation kinetics of the parent compounds as well as the formation of transformation products (TPs) were followed by ultra-performance liquid chromatography/quadrupole-time-of-flight mass spectrometry. Antibiotic activity test was based on the inhibition of bacterial growth (*Bacillus subtilis*), while toxicity test was performed with the freshwater green algae *Desmodesmus subspicatus*. At the applied experimental conditions, both biodegradation and ozonation experiments resulted in nearly full elimination of the tested parent compounds. The biotic and abiotic removal of all parent compounds was associated with the formation of different TPs, some of which were rather abundant and persistent to further degradation. The highest number of detected TPs was associated with the elimination of AZI, while the number of CLA and ERY TPs was lower. The biodegradation efficiency was the highest in experiments conducted at pH 7.85, while the ozonation experiments performed at a pH range of 2.25-3.60. Results demonstrated that the studied transformation processes, based on toxicity to algae and high resolution mass spectrometry, are very often only available in high-tech laboratories. The cost-competitive methodology presented here, successfully developed and validated, intends to fill the existing gap between current environmental needs and analytical capacities. It consists of an innovative method for the analysis of a large number of pollutant compounds in environmental samples. The method is based on Solid Phase Extraction (SPE) coupled to Liquid Chromatography Mass Spectrometry (LC-MS) and cost-effectively available in high-tech laboratories. The cost-competitive methodology presented here, successfully developed and validated, intends to fill the existing gap between current environmental needs and analytical capacities. It consists of an innovative method for the analysis of a large number of pollutant compounds in environmental samples.

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**DI-SPME - On-fiber Derivatization - GC-MS. An innovative green and cost-effective approach to determine CECs and TPs from a novel anoxic-aerobic photobioreactor**

R. López-Serna, University of Valladolid / Chemical Engineering and Environmental Technology; E. Posadas, P.A. García-Encina, R. Muñoz, University of Valladolid

The demand of multicomponent methods for the analysis of compounds of emerging concern in the environment has increased. Techniques based on high-resolution techniques. However, conventional techniques based on Solid Phase Extraction (SPE) coupled to Liquid Chromatography Mass Spectrometry (LC-MS) are very often only available in high-tech laboratories. The cost-competitive methodology presented here, successfully developed and validated, intends to fill the existing gap between current environmental needs and analytical capacities. It consists of an innovative method for the analysis of a large number of pollutant compounds in environmental samples. The method is based on Solid Phase Extraction (SPE) coupled to Liquid Chromatography Mass Spectrometry (LC-MS) and cost-effectively available in high-tech laboratories. The cost-competitive methodology presented here, successfully developed and validated, intends to fill the existing gap between current environmental needs and analytical capacities. It consists of an innovative method for the analysis of a large number of pollutant compounds in environmental samples.
plant tissue was documented. Formation of transformation products was assessed,
but the mass balances were not closed. Organic micropollutants sorption to support
matrix was low. Removal of different compounds was higher in summer than in the
winter. Planted reactors showed higher efficiency than unplanted reactors, stressing
the synergies between the plant and the microbial community. Unsaturated systems
tended to be more efficient. Removal correlated with the nitrification activity and
with the biofilm activity, suggesting that bacterial processes play an active role in
the micropollutants biodegradation. The removal of the organic micropollutants in
CWs is affected by several design and operational parameters. Plant uptake does
occur but phytoaccumulation is low as the compounds can be degraded inside the
plant tissues. Due to overlying effect of the plants, the extent of microbial
degradation could not be quantified. Further studies on transformation products in
this type of technical systems are needed.

PFAAs levels in the eggs and reproductive parameters, including the total hatching
success, eggshell thickness or the total breeding success. PFAAs levels in blood
correlated with protein damage in adult birds while in chicks they correlated with
higher activity of antioxidant enzymes (GPX and CAT). The obtained data
represent an important step towards the understanding of the behaviour, effects and
consequences of PFAAs in wild bird populations. [1] Buck RC, Franklin J, Berger
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Wildlife ecotoxicology: laboratory dosing studies to field
population assessments (II)

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Active and passive monitoring of lead poisoning in birds of prey in Spain
R. Mateo, IREC-CSIC- UCLM / Grupo de Toxicología de Fauna Silvestre; E.
Descalzo-Sanchez, Instituto de Investigación en Recursos Cinegéticos IREC
CSICUCLMJCCM; P.R. Camarero, Instituto de Investigación en Recursos
Cinegéticos, CSIC-UCLM-JCCM / Grupo de Toxicología de Fauna Silvestre; I.S.
Sanchez-Barbudo, UCLM-CSIC / Grupo de Toxicología de Fauna Silvestre
The ingestion of lead ammunition is the most important source of exposure to this
metal in birds of prey, and consequences on their health are well-know. The
objective of the present study is to improve our knowledge on the exposure to Pb in
birds of prey in Spain by means the integration of active and passive monitoring
programs based on Pb analysis in blood and liver of raptors and by the evaluation of
the effects on their health by using non-destructive blood biomarkers. We have
performed a passive monitoring by measuring blood (n=27) and liver (n=685) lead
levels in birds of prey of 16 species found dead or sick in Spain between 2004 and
2017, but also an active monitoring by measuring blood lead levels in birds (n=196)
of 9 species trapped alive in the field. Adverse effects of lead exposure on heme
biosynthesis, P/Ca metabolism, oxidative stress and immune function were also
evaluated in the active monitoring by means non-destructive biomarkers. The
active monitoring showed that some individuals of bearded vulture (1/3), Eurasian
griffon vulture (87/118), Spanish imperial Eagle (1/6) and red kite (1/18) presented
abnormal blood Pb exposure levels (>200 ng/ml). Passive monitoring revealed that
the species with lead levels in liver associated with clinical poisoning (18-30 µg/g
d.w.) were cinereous vulture (1/39), Eurasian griffon vulture (2/228) and western
marsh-harrier (1/32); and the species with clinical severe poisoning (>30 µg/g d.w.
of Pb in liver) were Eurasian griffon vulture (19/228), red kite (1/129) and golden
eagle (3/36). The study of biomarkers reveals a negative relationship between
δ-ALAD activity in blood and blood Pb concentration. Ca/P homeostasis was also
affected by Pb exposure, because elevated blood Pb levels were associated with
lower Pb levels and higher Ca:P ratio in plasma of birds. Carotenoid levels in
plasma were also increased in birds with higher blood Pb levels, indicating a
possible allocation of antioxidants in plasma to cope with adverse effects of Pb. The
integration of active and passive monitoring permits to have a more complete
perspective of the risk that Pb represents for raptors. Here we confirm with the
active monitoring the elevated blood Pb levels (73.7% with >200 ng/ml) in
field-trapped Eurasian griffons as found in previous studies, but also report a
significant mortality (8.3% with >30 µg/g d.w.) in Eurasian griffons and golden
eagles with the passive monitoring.

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Effects of PAH exposure on fuelling ability in a long distance migratory
shorebird
K. Bianchini, University of Saskatchewan - Toxicology Centre / Toxicology; C.A.
Morrissey, University of Saskatchewan / Biology
Many shorebirds are long distance migrants that stop to refuel along the journey
where they can be exposed to pollutants that may impede fuelling for migration.
Exposure to organic pollutants can cause potential effects on migration success,
speed and subsequent population parameters since pre-migratory fuelling is
correlated with reproductive performance upon reaching the northern breeding
grounds. The polycyclic aromatic hydrocarbons (PAHs) found in marine oil
pollution have the potential to interfere with pre-migratory fuelling physiology in
shorebirds. However, a link between PAH exposure and pre-migratory fuelling has
yet to be established. Our objective was to determine if PAHs or associated
contaminants can affect condition and fuelling rates in a captive shorebird, the
Sanderling and in the field at major shorebird stopovers. In this study, a captive
population of 49 Sanderling (Calidris alba) was orally dosed with a commercial
PAH mixture for 21 days at ecologically relevant concentrations (0, 12.6, 126, and
1260 μg PAH/kg body weight/day). We found that EROD activity was significantly
elevated in the high dose group relative to controls and fuelling rates and condition
were also lower in dosed birds. Higher PAH exposures were associated with
reduced serum bile acid concentrations, elevated serum creatine kinase
concentrations, and with high serum lipase concentrations (in females). These
results suggest that PAH exposure can interfere with lipid transport and metabolism
and can cause muscle damage leading to poorer condition. We also captured
Sanderling from the Gulf of Mexico, which is subject to recurring oil spills and
from Chaplin Lake, Saskatchewan, a relatively uncontaminated site. We measured
each bird’s body condition, fuelling status, and plasma PAH levels and attached
miniature radio transmitters to a subset of birds (n=75). Motus radio telemetry array
technology was used to determine the arrival and departure timing and stopover
duration. We found that mean stopover durations in the Gulf of Mexico were longer
than in Chaplin Lake (27 versus 15 days), and that stopover duration was associated
with body condition and fuelling status at capture. We also measured higher plasma
PAH concentrations in birds at certain Gulf sites, suggesting that PAH exposure is
associated with lower pre-migratory fuelling rates. This work will inform shorebird
conservation by providing valuable insight into a potential cause of migratory
shorebird declines.
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PFAAs levels, oxidative status and reproductive success in great tits (Parus
major) inhabiting a contamination hot-spot.
A. López Antia, Universiteit Antwerpen / Biology; T. Groffen, Systemic
Physiological and Ecotoxicological Research (SPHERE), University of Antwerp /
Biology; L. Bervoets, Universiteit Antwerpen; R. Lasters, E. Prinsen, H. Abd
Elgawad, University Antwerp; M. Eens, University of Antwerp / Department of
Biology
Perfluoroalkyl acids (PFAAs) are substances which have been produced for more
than five decades. Their unique properties of repelling both water and oil, make
them suitable for many industrial and consumer applications such as water and dirt
repellents for clothes and carpets, active components in firefighting foams or
precursors in Teflon® production [1]. Its extensive use, together with their high
persistence, has resulted in global contamination of the environment, wildlife and
even humans [2,3]. This ubiquity contrasts sharply with the limited amount of
available information about their effects on organisms. We report here PFAAs egg
and plasma levels in wild populations of great tits (Parus major) settled along an
established pollution gradient starting from a fluorochemical plant in Antwerp
(Belgium). Using two generations of great tits we have obtained important results in
some poorly known issues such as the differences between sexes, maternal transfer
of compounds or possible effects on the oxidative status or the reproductive
success. The levels we detected in eggs and plasma, demonstrate that Antwerp is
one of the major hot-spots in the world for perfluorinated compounds pollution.
With regard to the possible effects, negative correlations were observed between

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Persistence of elevated p,p'-DDE levels and HCB-related protoporphyrin IX
decrease in eggs of common kestrels from Tenerife (Canary Islands, Spain)
A. Buck, Instituto de Investigación en Recursos Cinegéticos IREC
CSICUCLMJCCM / Wildlife Toxicology; J. Carillo, University of La Laguna; P.
Camarero, IRECInstituto de Investigación en Recursos Cinegéticos; R. Mateo,
IREC-CSIC- UCLM / Grupo de Toxicología de Fauna Silvestre
Persistent organochlorine (OC) pesticides, including p,p’-DDT, have been banned
in many parts of the world for more than 30 years, but they are still present in the top
predators of terrestrial and aquatic food webs. The Canary Island were one of the
Spanish regions with the highest use of OC pesticides due to the intensity of its
agriculture. A previous study performed between 1988 and 1994 with 14 unhatched
eggs of West Canarian common kestrel (Falco tinnunculus canariensis) from
Tenerife Island showed elevated concentrations of p,p’-DDE (17.9 µg/g dw;
equivalent to 4.9 µg/g ww). Here, we have monitored the levels of OC compounds
(pesticides and polychlorinated biphenyls) in 40 unhatched eggs of West Canarian
common kestrels from Tenerife Island collected between 2009 and 2016. We have
also measured the porphyrin composition of the eggshells to explore the use of
these pigments as biomarkers of organochlorine pollution in birds. Biometry, status
of embryo development and eggshell thickness were recorded from each egg and
information about habitat characteristics were recorded for each nest. Because the
eggs were at different degrees of desiccation, the content was lyophilised in order to
measure OC concentrations in dry and lipid weight of content. OC analysis was
performed by extraction with n-hexane:dichloromethane (4:1), evaporation (for
lipid weight calculation) and resuspension in n-hexane, followed by four clean-ups
with sulfuric acid and determination by GC-ECD. For porphyrin determination,
eggshells were homogenized and extracted with acetonitrile:HCl 3N (2:1) and then

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analysed by HPLC-DAD. Egg content showed the following OC levels (mean ± SE; µg/g dw): p,p'-DDE, 152.5 ± 1.7; p,p'-DDT, 0.118 ± 0.020; PCBs, 0.459 ± 0.121; HCHs (hexachlorocyclohexane isomers), 0.021 ± 0.003; and HCB (hexachlorobenzene), 0.0042 ± 0.0004. p,p'-DDE levels have remained elevated for more than 20 years and these levels were statistically associated in generalized linear models with the surface of active and abandoned cropped land in a 200 m-radius around the nest (+), distance from nest to urban areas and greenhouses (-), altitude (-) and year (highest in 2011). PCB levels were associated with distance from nest to roads (-) and altitude (+). The shell index was not affected by p,p'-DDE levels, but decreased with embryo development. Propoxophyrin IX was the only pigment in eggshells and its content was negatively affected by HCB levels in egg content.

87 Long-term increase in secondary exposure to anticoagulant rodenticides in European polecats in Britain K.A. Samsbury, University of Exeter / Environment and Sustainability Institute; R. Shore, Centre for Ecology & Hydrology (NERC); H. Schofield, L. Croese, The Vincent Wildlife Trust; M.G. Perera, Centre for Ecology & Hydrology / Lancaster; D. Sleep, NERC Centre for Ecology & Hydrology; A.C. Kitchener, G. Hankle, National Museums Scotland; R. McDonald, University of Exeter / Environment and Sustainability Institute.

As a result of legal protection and population recovery in Great Britain, European polecats (*Mustela putorius*) are expanding into areas associated with greater usage of second-generation anticoagulant rodenticides (SGARs). We analysed livers from polecats found dead (mostly road casualties) from 2013-2016 for residues of five SGARs. We related variation in residues to polecats traits (age, sex, provenance), to potential exposure pathways by analysing stable isotopes of carbon (δ13C) and nitrogen (δ15N) in whiskers, and to data collected from polecats in the period 1992-99. In all, 54 of 68 (79%) polecats from 2013-16 had detectable liver residues of at least one SGAR. Bromadiolone (71%) was the most commonly detected compound, followed by difenacoum (53%) and brodifacoum (35%). Liver SGAR residues did not vary with sex or with the season in which the polecats died. We found a positive association between occurrence of liver SGAR residues and δ15N values. Polecats in Britain feed predominantly on rats and rabbits and our findings are consistent with the concept that individuals feeding on rats (higher trophic level than rabbits) are more likely to be exposed to SGARs. Total SGAR liver concentrations were higher in polecats from arable than pastoral habitats, consistent with more intensive SGAR use on arable farms, and higher in western than eastern regions although the reason for this is unclear. Both number of compounds and total SGAR concentrations were positively associated with age, presumably due to multiple sub-lethal exposures during an animal’s lifetime; older animals may thus be at most risk from poisoning due to progressive accumulation of liver residues. When we compared data for polecats from 2013-16 with those for polecats that died in 1992-99 and accounted for differences between studies in detection limits, we found that the rate of detection of SGARs in polecats in Britain increased 1.7 fold over the 25 year period. This increase was not restricted to newly recolonised areas and suggests an increase in the risk to polecats from SGARs throughout their range.

88 Poster spotlight: MO035, MO036, MO083

Environmental risk assessment in time and space: new approaches to deal with ecological complexity

89 The threshold option, the recovery option and landscape modelling P. Thorbeck, Syngenta / Environmental Safety; N. Galic, Syngenta / Environmental Safety; V. Forbes, University of Minnesota / Ecology, Evolution & Behavior.

Landscapescapes provide a multitude of ecosystem services, but the relationships between the populations of the organisms providing them, stressors and the delivered value are often complex and often nonlinear. In order to understand how pesticides may affect ecosystem services and biodiversity at the landscape scale, it is necessary to understand both exposure and effects at the organism level, but also how life history, movement patterns and farming activities such as tillage and harvest affect population dynamics. If this has to be done for all species in all landscapes in Europe the modelling task quickly becomes unmanageably complex, and the interpretation of the modelling outputs will be challenged. Here we present a tiered system for model design to aid managing the complexity. We outline what model design features are necessary for modelling based on species mobility and whether the ecological threshold option (ETO) or the ecological recovery option (ERO) is chosen. Ecological production functions quantitatively link the service-providing units to the services delivered and are therefore used directly to assess the population and landscape impacts of pesticides (e.g. biomass or functioning) contribute to the final ecosystem services enjoyed by the recipients. Such understanding can be used to set the protection goals for different service-providing units for both ETO and ERO. The attributes which link to service delivery can be difficult to measure at the landscape level, but by combining ecological models and ecological production functions, thresholds can be set for lower tiers of the risk assessments, which may be easier to measure. In some cases the ecological production functions are quite simple if a population directly delivers the service (e.g. for angling). However, in other cases, the link is far from straightforward and such ecological production functions have largely been ignored in pesticide risk assessment. This should be a priority area for future research.

90 Understanding risk - a better approach to reduce uncertainty M. Wang, WSC Scientific Gmbh / Dept E fate Modelling; M. Froudouakis, Dow Agrosciences / RSRA ERS.

For many compounds the intrinsic toxicity as determined in toxicity studies does not reflect toxicity and risk adequately. Rather other mechanisms determine which species are most at risk (local species) and how large the risk posed to these species is. These include for example elimination rates and feeding behaviour, which are not considered in the first tier. In the present presentation results from two case-studies are given which demonstrate how uncertainty in the risk assessment can be reduced by trying to understand mechanisms that lead to toxicity and mechanism determining the actual and long-term risk of mammals and birds in the field. Field data help to verify the obtained knowledge and to determine an empirical margin of safety. Finally, population modelling is used to answer what-if questions for answering questions on the relevance of effects in considering specific worst-case assumptions. In both example compounds metabolism and excretion together with feeding behaviour mainly determined the acute and long-term risk. All of these mechanisms are not considered in the first tier risk assessment and without these it would not be possible to understand the risk of the compounds shown here. This understanding significantly reduced the uncertainty of the risk assessment, because with the gained knowledge it is possible to identify critical scenarios.

91 Developing spatio-temporally realistic representations of agricultural landscapes for assessing the impacts of pesticides on non-target organisms E. Zielińska, Jagiellonian University / Institute of Environmental Sciences; C.J. Topping, Aarhus University / Department of Bioscience; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation; R. Laskowski, Jagiellonian University / Ecotoxicology & Stress Ecology Group. Species richness and population sizes in agro-ecosystems have decreased dramatically in the last decades. The current scheme of agricultural intensification resulting in landscape simplification is considered one of the main causes of this biodiversity loss, along with widespread use of pesticides. As the management of landscape heterogeneity seems to be crucial for maintaining vital populations in agro-systems, it is necessary to include the landscape component in ERA and as the important mitigation strategy. We present a methodological framework for modelling landscape heterogeneity considering specific worst-case assumptions. The framework has been implemented within the ALMaSS simulation system allowing to investigate the effects of changes in landscape structure and management on the population size and distribution of animals. We describe spatial landscape heterogeneity through a detailed land cover map, in which farmed areas are represented as accurate maps of fields grouped into farm units of different types (e.g. arable farmland). The current scheme of agricultural landscapes feasible and usable for landscape-spie risk assessment. More importantly, the presented tools allow for testing in silico various scenarios of agricultural practices, including pesticide use, in differently structured landscapes. This seems at the moment the most promising strategy for elaborating sustainable agricultural practices that would allow for high productivity, whilst still protecting the agrobiodiversity. This study was supported by the National Science Centre, Poland (2015/19/B/NZ6/01939).

92 Where are the Springtails? A vertical distribution model for Collombolans V. Roebe, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research BioV; L.S. Tschoppe, RWTH Aachen University / Institute for Environmental Research BioV; T. Preuss, Bayer Ag / Environmental Safety; A. Schaefier, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Ross-Nickoll, RWTH Aachen
University, Institute for Environmental Research / Institute for Environmental Research

With respect to environmental risk assessment it is crucial to know where and when to protect an organism but still little is known on the dispersal of collembolan communities in agricultural landscapes. Especially for the environmental risk assessment of plant protection products vertical movements can be relevant for exposure assessment of in-soil organisms. Thus, ecological modeling offers a powerful tool to link exposure and effects. We will present the individual-based model of the soil-dwelling collembolan *Folsomia candida* FOLCAS (*Folsomia candida* simulation). FOLCAS is a vertical distribution model simulating an agricultural soil column, which can be applied to demonstrate the effect of variations in environmental parameters on the population and its dispersal. In addition, the model features the option to evaluate the effect of a pesticide application. The model consists of two submodels: the lifecycle and the movement submodel. The movement of the individuals in FOLCAS is influenced by temperature, pore space, pH and the organic matter as a proxy for food availability. In order to assess the importance of food availability as a main trigger for movement a vertical distribution experiment was designed. In this experiment we assessed the vertical dispersal of *F. candida* in OECD soil in relation to food location and time. Transparent PVC columns were filled with 350 g OECD soil up to 20 cm column height and 86 individuals of *F. candida* of different age classes were added. Each column was divided in 6 compartments from top to bottom: 0-1cm, 1-2.5cm, 2.5-5cm, 5-10cm, 10-15cm and 15-20cm. The location of feeding was varied by different regimes while all other parameters were kept constant (21'C air temperature, 100% RH, 17h light:8h darkness). The food was either added with food at the top (1st), the middle (4th), the ground (6th) or at all three compartments simultaneously. The vertical distribution study will show that the dispersal of *F. candida* within a soil column is influenced by the location and availability of food. The study will give insights not only on the population dispersal in relation to food as a single stressor, but also on the population composition. The movement submodel of FOLCAS was parameterized and simulation results of the vertical dispersal of collembolans will be presented. A case study will be used to elucidate the importance of the vertical dispersal of non-target arthropods in effect assessment.

93 A practical application of an individual-based stickleback model in the ERA of PPPs
K. Mintran, University of Exeter / Biosciences; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; S.K. Maynard, AstraZeneca / Safety Health and the Environment; A. Brown, Exeter University / Biosciences; C. Liu, Syngenta / Institute of Environmental Security; S. Parker, Cefas Weymouth Laboratory; P. Thorbek, Syngenta / Environmental Safety.

Population models are employed in the environmental risk assessment (ERA) of chemicals, including plant protection products (PPPs), to extrapolate from individual-level effects to predictions of effects on whole populations. Individual-based models (IBMs) allow the incorporation of individual variability, population-level interactions and specific behaviors. IBMs can therefore be used to extrapolate from a large number of individual-level endpoints and simulate potential effects on populations under realistic environmental conditions. We present an IBM of the three-spined stickleback (*Gasterosteus aculeatus*) developed for the purpose of predicting population-level effects for exposure to chemicals. The IBM was developed from a series of sub-models parameterised from empirical data obtained in field experiments. Modeled population dynamics (e.g. size/age class distributions and annual fluctuations in population abundance) emerge from the adaptive traits, behaviours and interactions between individuals and their environment (including toxicant exposure). Here, we describe the development and validation of a stickleback IBM and demonstrate its practical application in ERA. Empirical data quantifying the reproductive effects and subsequent recovery, following exposure to a fungicide, were input into the IBM as a sub-model. Various exposure and recovery scenarios were simulated to predict population-level effects over time. The modelled outputs demonstrated that exposure duration and individual recovery post-exposure can influence the overall effects of chemical exposure on population abundance. We suggest that using IBMs to incorporate realistic exposure and recovery scenarios may improve current ERA and result in more realistic protection standards for wild populations.

94 Using the Bayesian network relative risk model to integrate molecular effects, ecological context and ecosystem services to estimate risk over space and time with the Pacific Northwest
M. Huang, BGR / Groundwater and Soil; D. Rückamp, E. Wargenua, A. Lamparter, C. Stange, S. Kaufhold, German Federal Institute for Geosciences and Natural Resources; E. Fries, Federal Institute for Geosciences and Natural Resources; P. König, German Federal Institute for Geosciences and Natural Resources; K. Schlich, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; K. Hund-Rinke, Fraunhofer IME / Institute of Ecotoxicology; M. Kraas, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Ecotoxicology; R. Mikutta, Leibniz Universität Hannover; J. Utermann, Federal Environment Agency; G. Guggenberger, Leibniz Universität Hannover

95 Mobilisation of silver sulphide nanoparticles in soil column by earthworms’ bioturbation
M. Baccaro, Wageningen University / Toxicology Department; H.H. van den Berg, Wageningen University / Department of Toxicology; D. Hermans, L. Sloot, Wageningen University and Research; N. van den Brink, Wageningen University / Dept. of Toxicology.

Ag2S-NP is the main product of transformation of Ag-NP in the waste water treatment plant (WWTP). In many European countries, sewage sludge containing Ag2S-NPs is applied on the surfaces of soils as soil amendments. Earthworms are important ecological engineers in the soil ecosystem, which, on one hand, may be affected by Ag released from the amendments and, on the other hand, may influence the distribution of metals. Therefore, the aim of this study was to determine effects of Ag2S-NP application on an important earthworm driven process, i.e. bioturbation and the effect of the earthworm activity on the vertical distribution of Ag2S-NP in the top soil. Their interplay was assessed in two experiments, in presence or absence of artificial rain fall. Around 2 cm of soil treated with 10 mg Ag kg-1 dry weight soil of Ag2S-NP (28.0±20.4 nm) was applied on top of natural soil columns (10 cm) mimicking an application of 200 Mg sludge ha-1 dry weight. For the first experiment, columns were prepared with and without Lumbriicus rubellus and with and without Ag2S-NPs. Every week for 28 days earthworms and four different layers of the soil columns (0-2, 2-4, 4-6, 8-10, 10-12 cm depth) were sampled. In the same way a second experiment was performed with daily addition of 2 nm of artificial rain water, allowing collection of leakage samples from the bottom of the columns. Total Ag content was measured in all samples by ICP-MS following acid digestion and nano-Ag in leakage samples by sICP-MS. Results of the first experiment show that mobility of Ag along the soil column is significantly higher in the columns with earthworms overtime. Ag reached the bottom layer of the columns where worms were present while no Ag was found at the bottom layer of the column without worms. This indicates that earthworms do not avoid the contaminated top layer. Ag content in earthworms was relatively constant overtime with an average value of 1.06±0.32 mg Ag kg-1 dry weight. The first study shows that uptake of Ag2S-NPs in earthworms occurred regardless of the partial exposure and points towards the crucial role of earthworm bioturbation in the mobilisation of metal nanoparticles in the top soil. The second experiment of the study is currently being performed, results will be presented at the meeting.

96 Short- and long-term approaches to determine the fate of silver nanoparticles in seawater

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Engineered silver nanoparticles (Ag ENP) are present in many consumer products. Hence, the ENP enter into sewers and wastewater treatment plants with a high predicted removal into the sludge. If the sludge is applied to agricultural soils, compostation might result in resuspension of the ENP. The fate and impact of Ag ENP in soils is still unclear. Short- and long-term column remobilization experiments with disturbed soils, short-term column percolation experiments with undisturbed soils, and long-term field lysimeter experiments were conducted. All experiments were performed with sterically stabilized Ag ENP (AgNM-300k), and a slightly loamy Cambisol (ReSoIL 01A). Additionally, a medium clayey silt (Luvisol) was used for the column experiments. The column remobilization of the Ag concentration after digestion (Ag$_{\text{digg}}$) was on a very low level in all percolation steps in both soils. The first percolation step after three days of the Cambisol incubation showed the highest remobilization of Ag which was below 5% of the Ag$_{\text{digg}}$ concentrations in the soil columns. The correlation between remobilized Ag$_{\text{digg}}$ and Ag$_{\text{digg}}$ concentrations suggests that the remobilized amount of Ag was associated to soil colloids. The breakthrough of Ag ENP in the column percolation experiments was high but incomplete in the Cambisol and the Luvisol. Particularly, columns with preferential flow pathways showed low Ag ENP retardation. In the unsaturated experiments, a nearly complete retention was found for the Luvisol that showed a clearly smaller pore size structure than the Cambisol. The horizontal displacement of Ag$_{\text{digg}}$ in the lysimeter experiments was low and very likely related to soil tillage as well as bioturbation. A low Ag$_{\text{digg}}$ release to the percolate water (= 480 d, control = 24 ng l$^{-1}$, Lysimeter (7 mg kg$^{-1}$) = 56 ng l$^{-1}$, DIN 38402-11) was obtained for the lysimeter with the highest Ag ENP application. TNP$_{\text{digg}}$ release from a precalculated packed column existing this in different soils sampled in the UK. Artificial rainwater was used as the eluent. 10 mM NaNO$_3$ was used as a conservative tracer to estimate the effective porosity and dispersivity. All columns were packed with an excess of rainwater to limit the amount of air present in the saturated soil. α was either calculated from breakthrough curves of Au/Ag or from the irreversible attachment rate modelled using Hydrus 1D or the ratio of the recovery of the ENPs in the break through curves. Preliminary results show no significant differences in α values for 80 nm and 20 nm Au ENPs. However, the Au ENP breakthrough curves appeared dependent on the flow rate. Even though the shape of the break through curves changes with flow rate, this can be compensated during modeling arriving at consistent α values between the systems with varying flow rates. Furthermore, presence of air in the column affects the distribution of ENPs in the packed columns. Finally, an increase in initial ENP concentration give higher α values and cannot be accounted for in the equations used for estimating the attachment efficiency. In conclusion, when varying the initial ENPs concentration into the columns, the α value is significantly affected. Hence, low NP concentrations need to be used in the column experiments to measure the reproducibility of calculated α values. Moreover, inclusion of air in the systems appears to induce artefacts that complicate determination of α for specific NP-soil combinations.

97 Determination of attachment efficiency (α) for ENPs in different types of soils by saturated column experiments K. Norrofs, SLU Uppsala / Soil and environment; G. Cornelis, Swedish University of Agricultural Sciences / Soil / and environment

The attachment efficiency (α) has been suggested as the most appropriate fate descriptor for transport of engineered nanoparticles (ENPs) in soils and saturated column experiments as the most accurate method to obtain α. Due to the complexity of the soil composition and texture, a small change in performance of the column protocol may affect the resulting attachment efficiency obtained from the results. The aim of this work is to study the effect of soil composition, flow velocity, initial ENP concentration and the size of ENPs on the calculated attachment efficiency for the specific ENP-soil systems. The α values for nominally 20 and 80 nm citrate coated gold ENPs (Au ENPs), as well as 30 nm sulphonated silver ENPs (Ag S ENPs) were induced to percolate through a packed column existing this in different soils sampled in the UK. Artificial rainwater was used as the eluent. 10 mM NaNO$_3$ was used as a conservative tracer to estimate the effective porosity and dispersivity. All columns were packed with an excess of rainwater to limit the amount of air present in the saturated soil. α was either calculated from breakthrough curves of Au/Ag or from the irreversible attachment rate modelled using Hydrus 1D or the ratio of the recovery of the ENPs in the break through curves. Preliminary results show no significant differences in α values for 80 nm and 20 nm Au ENPs. However, the Au ENP breakthrough curves appeared dependent on the flow rate. Even though the shape of the break through curves changes with flow rate, this can be compensated during modeling arriving at consistent α values between the systems with varying flow rates. Furthermore, presence of air in the column affects the distribution of ENPs in the packed columns. Finally, an increase in initial ENP concentration give higher α values and cannot be accounted for in the equations used for estimating the attachment efficiency. In conclusion, when varying the initial ENPs concentration into the columns, the α value is significantly affected. Hence, low NP concentrations need to be used in the column experiments to measure the reproducibility of calculated α values. Moreover, inclusion of air in the systems appears to induce artefacts that complicate determination of α for specific NP-soil combinations.

98 The transformation of copper and zinc (-nanoparticles) during sewage sludge composting. J.J. Wielinski, ETH Zürich/Eawag / Process Engineering; A. Gogos, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Process Engineering, Particle Lab; A. Voegelin, Eawag Swiss federal Institute of Aquatic Science and Technology; E. Morgenroth, Eawag Swiss federal Institute of Aquatic Science and Technology / Process Engineering; R. Keagi, Eawag - Swiss federal Institute of Aquatic Science and Technology

Engineered nanoparticles in wastewater streams are effectively retained by wastewater treatment plants and accumulate in sewage sludge. Digested sludge is subsequently combusted for further volume reduction to allow for phosphorous recovery at a later stage. This study focuses on two metals Cu and Zn, as both are present in digested sludge but are also used as nanomaterials. We investigated (i) the transformation of ZnO and CuO-NP during anaerobic digestion, (ii) the subsequent transformation of Cu and Zn during sewage sludge combustion, and (iii) whether the form of Cu and Zn affects the fate during anaerobic digestion and combustion. We spiked CuO-NP, ZnO-NP, Cu$^{2+}$ and Zn$^{2+}$ to four aliquots of raw sewage sludge in duplicate and maintained four different digestion conditions for 24h. One aliquot was kept as control. Thereafter, sludge was combusted in a pilot fluidized bed reactor and ashes were collected. Sludge and ashes were prepared for Cu - and Zn K-edge X-ray absorption spectroscopy (XAS) measurements. The speciation of the metals was obtained through linear combination fitting (LCF) of X-ray absorption near edges spectra (XANES) and extended X-ray absorption fine structure (EXAFS) data. LCF fits of experimental XANES and EXAFS data suggest a high degree of sulfidation of both Cu and Zn during anaerobic digestion, irrespective of the spiked form of Cu and Zn. For control sludge and sludge spiked with Zn$^{2+}$, LCF results from EXAFS data suggest that ~90% of the Zn was present as sulphides, the remaining fraction was best described by a ZnO reference spectrum. For sludge spiked with ZnO-NP, a lower degree of sulfidation (~33% ZnS) with a concomitantly high fraction of ZnO (17%) was calculated. After combustion, EXAFS spectra of Zn were best described by a spectrum of Zn that was co-precipitated with Ferrihydrite. All LCF fits of Cu in the digested sludge indicated complete sulfidation of Cu. After combustion, LCF fits of the experimental EXAFS spectra revealed the presence of ~30% Chalcopyrite, indicating that Cu was not completely oxidised during the combustion. Comparable fraction of Cu in Znsp and CuO was returned from LCF analyses. All Cu spectra of the sludge and the ashes were similar and independent of the added form of Cu. For Zn, however, the addition of ZnO-NP resulted in a slightly lower degree of sulfidation compared to the control sludge and to the sludge that was spiked with dissolved Zn$^{2+}$. All Zn spectra of the ashes were comparable.

99 Soil ecotoxicity and dissolution of a marketed nanosilver product - a direct comparison with ionic silver J. Merten, Precious Metals and Rhenium Consortium c/o EPMF; K. Arjs, ARCHE; É. Smolders, Katholieke Universiteit Leuven; D. Leverett, wca; K. Oorts, ARCHE

As part of the REACH Substance Evaluation for silver, new data was generated to further justify read-across from ionic silver to silver nanoforms. Therefore, the soil ecotoxicity and dissolution of ionic silver vs nanosilver were tested. The smallest silver nanoform with the highest specific surface area registered under REACH was used for testing (aqueous suspension containing approximately 37% nanoparticles, degree of sulfidation (~83% ZnS)) with a concomitantly high fraction of ZnO (17%) was tested as source of ionic silver. Soil nitrification was tested according to the internationally standardised and accepted assay for testing toxicity to soil microorganisms (OECD Test Guideline No. 216). Three soils were selected falling within the P10-P90 interval of European agricultural soils for pH, organic carbon content and cation exchange capacity. Total silver in soil, and total dissolved (0.45 μm) copper and silver (Cu and Cd) were measured using a plasma emission spectrometer. For soluble and Zn K-edge XANES and EXAFS data were measured (ICP-MS). Toxicity of nanosilver on soil nitrification was similar to or less than silver nitrate when expressed on the basis of total Ag in soil. Total and truly dissolved Ag in porewater decreased over time after silver nitrate spiking, suggesting ageing processes. Concentrations were always higher or equal to corresponding values after nanosilver spiking. For nanosilver spiking, total and truly dissolved Ag in porewater initially increased and lasting dissolution processes. From day 4-7 after spiking onwards, concentrations decreased over time suggesting that ageing becomes more important than dissolution. Truly dissolved Ag in porewater qualitatively explained observed toxicity of silver nitrate compared to nanosilver. The data show that soil ecotoxicity data for ionic silver are conservative for soil ecotoxicity of nanosilver.

100 Tackling nanoparticle fate assessment in surface waters - heteroaggregation as a key process H. Walsh, University of Vienna, Dep. of Environmental Geosciences / Environmental Geosciences, M. Frühauf, T. Hofmann, University of Vienna / Department of Environmental Geosciences

The increasing use of engineered nanoparticles (ENPs) inevitably entails emissions to the environment, raising calls for nano-specific environmental risk assessment approaches and regulations. As surface waters are the major receiving compartment, assessing risks requires understanding the aquatic fate of ENPs where, unless soluble, interactions (aggregation, including nano- and heteroaggregation with natural suspended particulate matter (SPM)), or stabilisation by natural organic matter (NOM). Due to the omnipresence and larger size of SPM, heteroaggregation is much more likely than homooaggregation. However, integration of this process into fate models and exposure assessment requires parametrisation and is still limited by the lack of simple, yet environmentally relevant experimental protocols. Such could be developed along the lines of the recently adopted OECD testing guideline 318 on ENP dispersion stability, currently accounting only for homooaggregation. The principles of homo- and heteroaggregation are basically the same: the probability of particle attachment is
controlled by the intrinsic particle properties and modified by the hydrochemical conditions (pH, electrolytes, NOM). Distinct from heteroaggregation is the complexity added to the system by SPM in the case of heteroaggregation. In this contribution we therefore propose an approach to develop a heteroaggregation testing protocol based on the OECD TG 318, with a focus on tackling SPM analogues selection. The development of such a protocol requires (1) selecting SPM analogues and their characterization to represent relevant environmental characteristics, and simple enough for routine testing, (2) a simple, easy-to-handle experimental setup to estimate a heteroaggregation parameter, and (3) an accurate experimental method to validate the latter. Point (1) requires informed simplifications based on a profound understanding of the system. Relevant hydrochemical testing conditions have been established for heteroaggregation in the OECD TG 318 and will also apply for heteroaggregation. However, suitable analogues for natural SPM still need to be selected. We therefore reviewed literature for typical compositions of riverine SPM and carried out screening tests aiming at the creation of complex analogues representing relevant characteristics. Comparisons with simple SPM analogues revealed distinct aggregation behaviour, indicating the importance of complex SPM analogues for heteroaggregation.

Advances in environmental risk assessment of oil spills and offshore oil & gas operations (II)

101 MC-252 biomarkers as indicators of oil exposure and pollutant concentration in sediments of the northern Gulf of Mexico

L.M. Basirico, Louisiana State University; R.J. Portier, Louisiana State University / Environmental Sciences

Different types of crude oil can be identified by the arrangement of constituents, or their chemical fingerprint. In addition, chemical fingerprinting can be used to associate contaminated sediments with specific spill events like the Deepwater Horizon disaster of 2010. Mississippi Canyon-252 (MC-252) source oil, the type of crude oil specific to the Deepwater Horizon event, has been fully characterized by researchers at LSU, including pattern identification of the ion 217 and 218 (heptane/sterane biomarker families. The presence of biomarkers in the sediments allows for the identification of MC-252 crude oil intrusion into sampled areas, as the arrangement of the ions delineates the source of the quantified PAHs. From 2012 to 2014, five inshore and three offshore transects representing the major estuarine and shuffling regions of the Mississippi River delta were sampled to measure sediment concentrations of polycyclic aromatic hydrocarbons (PAHs) and MC-252 biomarkers. Pattern A, pattern B or NO pattern was assigned to each sample based on a visual assessment of the chromatographic profiles. Additionally, a main effects-model was implemented in order to determine the impact of environmental variables, including the presence and pattern of MC-252 biomarkers, on the sediment concentrations of ten PAHs and three toxicity indicators. Ninety-three percent of all sampled sediments (N=1,032) did not contain MC-252 biomarkers. Of the sediment samples containing detectable crude oil biomarkers, 5 percent displayed pattern A and 2 percent, pattern B. Most of the samples containing the families of biomarkers were located at the southern end of the Barataria Bay transect, a region that experienced moderate to heavy oiling during the Deepwater Horizon oil spill event. Additionally, MC-252 biomarkers did not account for any of the variability in the concentrations of the measured pollutants across the different samples. A model was developed to predict the concentration of PAHs in sediments based on the fish toxicity caused by PAH exposures. We also report the effects of various UV modifications to PAH mixtures. We previously reported that PAH mixtures, when exposed to PAHs, were able to induce toxicity during periods of light exposure. Here, we report the results of experiments in which larval sponges were exposed to polluted seawater or sediments. Filtration rate was significantly decreased in sponges exposed to contaminated seawater or sediments, and filtration rate did not recover for 48 h after the end of the exposure to contaminated seawater. The transcriptome has been sequenced and analysis is underway to detect changes in gene expression patterns associated with treatments. Overall, results indicate that sponges respond to short-term exposure to crude oil and/or dispersants by cessation of their filtration behaviour. These initial results and our ongoing investigations will contribute to better understand the sensitivity of marine sponges to oil production activities.

104 Advances in the effects of UV on oil toxicity in aquatic organisms

A.P. Roberts, K. Bridge, University of North Texas / Advanced Environmental Research Institute; J. Morris, Abt Associates; B.J. Venables, University of North Texas / Advanced Environmental Research Institute; M.O. Krasnec, Abt Associates; M.L. Gielazyn, NOAA / NIEA Region IV

40-hydroxy-252 crude oil intrusion into sampled areas, as the arrangement of the ions delineates the source of the quantified PAHs. From 2012 to 2014, five inshore and three offshore transects representing the major estuarine and shuffling regions of the Mississippi River delta were sampled to measure sediment concentrations of polycyclic aromatic hydrocarbons (PAHs) and MC-252 biomarkers. Pattern A, pattern B or NO pattern was assigned to each sample based on a visual assessment of the chromatographic profiles. Additionally, a main effects-model was implemented in order to determine the impact of environmental variables, including the presence and pattern of MC-252 biomarkers, on the sediment concentrations of ten PAHs and three toxicity indicators. Ninety-three percent of all sampled sediments (N=1,032) did not contain MC-252 biomarkers. Of the sediment samples containing detectable crude oil biomarkers, 5 percent displayed pattern A and 2 percent, pattern B. Most of the samples containing the families of biomarkers were located at the southern end of the Barataria Bay transect, a region that experienced moderate to heavy oiling during the Deepwater Horizon oil spill event. Additionally, MC-252 biomarkers did not account for any of the variability in the concentrations of the measured pollutants across the different samples. A model was developed to predict the concentration of PAHs in sediments based on the fish toxicity caused by PAH exposures. We also report the effects of various UV modifications to PAH mixtures. We previously reported that PAH mixtures, when exposed to polluted seawater or sediments. Filtration rate was significantly decreased in sponges exposed to contaminated seawater or sediments, and filtration rate did not recover for 48 h after the end of the exposure to contaminated seawater. The transcriptome has been sequenced and analysis is underway to detect changes in gene expression patterns associated with treatments. Overall, results indicate that sponges respond to short-term exposure to crude oil and/or dispersants by cessation of their filtration behaviour. These initial results and our ongoing investigations will contribute to better understand the sensitivity of marine sponges to oil production activities.
Photon-enhanced toxicity is a distinct mechanism of petroleum toxicity that is mediated by the interaction of solar radiation with specific polymeric aromatic compounds (PACs) in oil. Phototoxicity is observed as a 2 to greater than 1000-fold increase in chemical toxicity to aquatic organisms that have also been exposed to light sources containing sufficient quantity and quality of ultraviolet radiation (UV) to excite light energy to photoreactive intracellular targets. Such light-weathered mid distillates, crude and heavy oils can exhibit photon-enhanced toxicity. These same products do not exhibit phototoxicity in standard test protocols because of low UV irradiance in laboratory lighting. Fresh water, estuarine and marine waters have been shown to have sufficient solar radiation exposure to elicit photon-enhanced toxicity, and a diversity of aquatic invertebrate and fish species can exhibit photon-enhanced toxicity when exposed to combinations of oil and UV. Risks of photon-enhanced toxicity will be greatest to early life stages of aquatic organisms that are translucent to UV and that inhabit the photic zone of the water column and intertidal areas exposed to oil.

106 Pilot microcosm study to assess the fate and toxicity of diluted bitumen in an outdoor aquatic environment.
J.M. Blais, University of Ottawa / Biology; M.L. Hanson, University of Manitoba / Environment and Geography; D. Ornhel, Queens University; B. Hollebone, Environment Canada / Emergencies Science & Technology; V. Palace, M. Paterson, IISD-Experimental Lakes Area; J. Rodriguez Gil, University of Ottawa / Department of Biology

Pipeline are the safest mode of transporting Canada’s oil to markets, but they are a concern for the public, especially the potential effects of diluted bitumen (dilbit) spills on the environment. We added diluted bitumen (dilbit) to two land-based microcosms (2 m diameter) containing water and sediment from a nearby lake at the IISD-Experimental Lakes Area in Northwestern Ontario for a span of 11 days, and compared our results to a control enclosure with no added dilbit. Microcosms were treated with 0 (Control), 0.15, or 1.5 liters of Cold Lake Winter Blend dilbit (CLB-W), representing dilutions of 1:10,000 and 1:1000 oil/water, v/v, which spans the range of historical dilbit spills to water. Samples of water, sediment, air and oil were collected from the study in order to determine the fate, weathering, and behaviour of the dilbit. Total petroleum hydrocarbons in the high treatment microcosm gradually increased from under 100 mg/L in the first 24 hours to over 1200 mg/L by day 11, with no evidence of reaching equilibrium over this duration. Although a decrease in total phytoplankton biomass was observed in all microcosms over the study, the biomass in the high microcosm was about one-half or less than that in the control microcosm for the first week. Thereafter, the rate of biomass loss in the dilbit-treated microcosms slowed down, which could indicate recovery of the primary producers as the oil slick sank to the sediments. This study is among the first to examine the behaviour of dilbit in an outdoor setting under natural conditions of sunlight, wind, and rain, and provides a case study that will inform future dibit studies in natural (outdoor) environmental settings.

Fish model species in human and environmental toxicology (II)

107 Life-stage, and species-specific effects of dietary methylmercury exposure K. LaBelle, University of North Texas / Advanced Environmental Research Institute; Y. Zhang, University of North Texas Health Science Center; T. Curran, J.T. Magnuson, University of North Texas / Biology; M. Allen, University of North Texas Health Science Center; B.J. Venables, A.P. Roberts, University of North Texas / Advanced Environmental Research Institute

Mercury is a globally distributed contaminant, found even in remote aquatic ecosystems. Once deposition occurs, it can be microbially transformed into organic forms, such as methylmercury (MeHg) [1]. MeHg is highly bioavailable, and it bioaccumulates and biomagnifies in biota leading to potentially toxic body burdens in long-lived organisms at high trophic levels. MeHg can be actively transferred from mother to offspring, through large amino acid transporters with the potential to cause severe, irreversible effects on developing organisms. Here, we describe the developmental effects of exposure to maternally bioaccumulated MeHg in a model fish species (Pimephales promelas). Exposure to environmentally relevant concentrations of MeHg during development led to alterations in the dopaminergic system, metabolism, gene expression, behavior, hatch time, size, and embryo larval survival. Similarly, effects on the dopaminergic system in specific regions of the adult P. promelas brain were observed after a 30-day dietary exposure. Recently, a functional link between gut microbiota and dopamine production in teleost has been established. The bidirectional communication between the gut and the central nervous system (CNS) is referred to as the gut-brain axis, which plays an important role in behavior, brain function, neurodevelopment, and the progression of neurodegenerative disorders. Therefore, we characterized MeHg-mediated changes to the gut microbiome composition in P. promelas adults. Because the dopaminergic system is highly conserved among taxa, we sought to confirm the altered dopamine concentrations in P. promelas brains a higher vertebrate species. Metabolomics was performed on the mid-brains of male mice (Mus musculus CD-1) exposed to similar concentrations of dietary MeHg for 30-days. Changes in dopamine concentrations of the teleost brain were mirrored in the mid-brains of male mice, and several other significant changes to the mouse mid-brain metabolome were detected. Collectively, these results suggest current environmental exposure scenarios to MeHg are sufficient to induce a number of molecular-level changes that are associated with costs to whole organism fitness, with consequences for multiple life stages, and species. Due to the similar changes detected in mice, there is increasing evidence to suggest teleosts as a surrogate model species for studies assessing effects of MeHg on highly conserved systems in higher vertebrates.

108 Characterization of molecular toxicity pathways of Fluoxetine in rainbow trout and white sturgeon using RNA-Seq whole transcriptome analyses A. Alcaraz, University of Saskatchewan - Toxicology Centre / Toxicology Centre; B.K. Eihsen, University of Saskatchewan / Toxicology Centre; S. Tang, Chinese Center for Disease Control and Prevention; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

The increasing number of emerging chemical contaminants (ECs) and their unknown effects to aquatic ecosystems serves as an impetus to develop advanced environmental risk assessment (ERA) approaches to improve regulatory decision-making. This is because current ERA rely on live animal testing that are expensive, time consuming and of ethical concern. Furthermore, the use of model organisms does not assure protection towards native species because of the limited immune study of their species, allowing the risk of toxicity. Hence, there is a need to establish an unbiased approach to characterize toxicity pathways that allow probing of an entire biological system without a priori knowledge of the mechanisms of toxicity. Advances in `omics technologies can improve current testing strategies as they offer high-throughput and cost-effective approaches to examine patterns of mechanistic toxicity which could guide endpoint selection across species or different life stages. The objective of this study was to use toxicology pathway models to predict outcomes of regulatory relevance for the selective serotonin reuptake inhibitor, fluoxetine (FLX), in 2 fish species of concern in Canada. Juvenile rainbow trout (RBT) and white sturgeon (WS) were exposed to 125 μg/L FLX in 96th static renewal system, and sequence-by-synthesis whole transcriptome analysis was used to determine unique differentially expressed genes in fish livers and brains. A 0.05 cut-off false discovery rate identified differentially expressed contigs between FLX and control groups. A total of 406 and 429 contigs were significantly altered in RBT livers and brains, respectively. Of these, 238(59%) and 236(55%) matched unique gene names. In WS, 252 and 192 contigs were significantly altered in livers and brains, respectively, with 145(58%) matched unique gene names. Together, the results support prospective toxicology pathway analysis using ontologies based on zebrafish in KEGG and GO Consortium showed a total of 101 affected pathways. Over half(58%) of the affected pathways were involved in biological processes while others were involved in cellular components (13%), molecular function (18%), and genetic information processing (11%). The results of this study will be compared to apical outcomes assessed in a parallel chronic study, and which will allow the assembly of toxicity pathways across multiple levels of organization with the end goal of identifying molecular markers that are indicative of adverse effects.

109 Transgenerational effects of early life stage exposure to endocrine disruptors across biological scales in a euryhaline model fish S.M. Branden, Oregon State University / Environmental and Molecular Toxicology; B. DeCorten, J. Forbes, University of North Carolina Wilmington / Biology and Marine Biology; N.P. Burns, University of North Carolina Wilmington / Department of Biology and Marine Biology; H. Roark, Hunter Roark / Biology and Marine Biology; J.W. White, Oregon State University / Department of Fisheries and Wildlife; A.C. Mehinto, Southern California Coastal Water Research Project / Toxicology; M.L. Settles, University of California Davis / Genome Center; R.E. Connon, University of California, Davis / School of Veterinary Medicine

Emerging research demonstrates that EDCs, which agonize, antagonize, and/or synergize the effects of endogenous hormones, can cause deleterious effects in addition to the known effects of early-life exposure as well as the subsequent effects on next generation. A flurry of studies exist of model fish species, such as Menidia beryllina, a euryhaline fish with short generation time that is found throughout North America and is demonstrated to be sensitive to contaminants. As such, we exposed Menidia beryllina embryos (8 hpf) until 21 dph to dioxin-like/estrogenic or estrogenic EDC of emerging concern: levonorgestrel (Levo) (10 ng/L), bimatoprost (Bi) (5 ng/L), respectively, and coupled this exposure with testing of an established androgenic or estrogenic EDC: tribenzone (TB) (10 ng/L), and ethynylestradiol (EE2) (5 ng/L). We are now evaluating the potential for transgenerational EDC effects across three generations, with EDC exposure isolated to the parental generation (to 21 dph) only, across biological scales. This study is examining changes in gene expression, DNA methylation, histological analysis of reproductive organs, as well as altered fecundity, sex ratio, morphology, and immune response in the F0, F1, and F2. We are also sequencing the M. beryllina genome. F0 results show that early-life exposure to EE2 significantly skewed adult sex ratios (feminized) relative to controls. Findings from the F0 and
F1 generations demonstrate that exposure to EDCs increased growth in the parental larvae, and that androgenic treatment groups (Levo, TB) maintain this growth through the subsequent F1 generation. In the F0 adults, differences in immune response are apparent between bifentrin and levonorgestrel, and this pattern is stronger in F1 adults, with significantly greater T-cell proliferation in bifentrin-exposed individuals relative to controls. Bifentrin-exposed parental females have increased atriotic follicles, and developmental defects are more pronounced in F1 embryos and larvae relative to parents. Future data gathered on gonadal histology, gene expression and DNA methylation will allow us to further hone in on the mechanisms causing higher order downstream effects. Elucidation of the mechanisms contributing to these higher order downstream effects will inform adverse outcome pathways, as well as allow for the quantification and comparison of responses to established and emerging endocrine disruptors across multiple biological scales.

110 Integrated OMICS and imaging for a better understanding of ecotoxicological mechanisms - PAH developmental toxicity as an example

E. Vehmänen, C. Rigaud, A.N. Eriksson, University of Jyväskylä / Department of Biological and Environmental Science; A. Krasnov, NOFIMA; M. Keinänen, University of Eastern Finland; A. Rokka, S. Sarai, T. Suomi, Turku Centre for Biotechnology; A. Laiho, University of Turku and Abo Akademi University; J. Lihavainen, University of Helsinki; J. Haverinen, M. Vornanen, University of Eastern Finland; J.V. Kaukonen, University of Jyväskylä / Biological and Environmental Sciences

Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous contaminants in the environment. Many of them cause developmental defects in fish, and cardiovascular tissue seems to be the most sensitive tissue. The mechanisms of toxicity remain largely unresolved for many PAHs, though partial adverse outcome pathways (AOPs) exist for those that are aryl hydrocarbon receptor (AhR) agonists. Retene and fluoranthene (Oncorhynchus mykiss) yolk sac larvae were exposed to sublethal concentrations of PAHs that act via different mechanisms of toxicity: Retene, an AhR agonist causing dioxin-like toxicity; pyrene and phenanthrene, weak AhR agonists causing toxicity independently of AhR; and fluoranthene, a CYP1A1 inhibitor interfering with PAH metabolism. Also the effects of a mixture of retene and fluoranthene were studied. Information was gained at multiple levels of biological organization to reveal the mechanisms of toxic action. Changes in cardiac transcriptome, proteome and metabolome were explored over time. Physiology and function of the heart were also studied. At the whole organism level, growth, yolk consumption, and developmental defects and abnormalities were monitored. Each PAH caused a unique pattern in OMICS analyses, and the mixture of retene and fluoranthene caused a different transcriptomic profile from that of each of the single compounds. Retene differentially regulated genes involved e.g. in muscle contraction and ion metabolism (ion channels). Retene and phenanthrene impaired cardiac function in larval rainbow trout. Both caused bradycardia, and phenanthrene caused also arrhythmias. Phenanthrene affected cardiomyocyte electrical characteristics. As cardiovascular development is modulated by the beating heart and blood flow, alterations in cardiac function during development may have long-lasting impacts in cardiovascular tissues. Different PAHs clearly have different mechanisms of toxicity. The transcriptomic changes can at least partly account for the cardiotoxicity of retene, but the cardiotoxicity of phenanthrene seems to involve a direct effect on cardiac ion channels.

111 Physiological / Reproductive Status of Native Fish Exposed to a Complex Chemical Mixture in the BioBio River, Central Chile

M. Quirodo-Jara, Universidad de concepcion / Biomarcadores; S. Casini, University of Siena / Scienze Fisiche della Terra e dell’Ambiente; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment; R.O. Barra, Universidad de concepcion / Celular Biology, Faculty of Biological Science

The BioBio River (Central Chile) is the third most important basin in Chile and is considered a Biodiversity Hot Spot with 17 native species. It presents a high degree of intervention due to the use of water resources for various industrial, agricultural and urban activities, with many focal places of point and diffuse contamination along its main axis, in addition to a high degree of modification of land use associated with the basin. The high degree of intervention and fragmentation of this river has affected the biota and water quality mainly in its lower third, due to the convergence of complex chemical mixture and anthropic interventions in the main course. The objective of this study is to determine how the development associated with this river impacts the physiological/reproductive state of the native species Percilia irwini (n = 66) in situ. Different sublethal responses were evaluated through biomarkers at different levels of biological organization (Biochemical, cellular, and individual) and environmental parameters (pH, temperature, conductivity and total dissolved solids). The results obtained indicate an increase in the Hepatic EROD activity (ethoxyresorufin-O-deethylation) towards the lower third of the river. The Gonadosomatic Index (100 * (Total weight / (Total weight - Gonadal weight))) shows an increase towards the lower third, however, the gonadal histology indicates a protoplasmic growth and reduction of the diameter of the different stages of development of the oocytes determined for this species (n = 2332, p < 0.05). On the other hand, the collected specimens show a difference in weight and length, presenting specimens of less frequency of length in the lower third with respect to those present in areas with less intervention. These responses are associated with the increase of the values of environmental parameters towards this zone. The results of this study indicate a gradient of adverse biological effects by the convergence of point and diffuse contamination of complex chemical mixture and establishes the possible relationships between the physiological/reproductive alterations observed and the high degree of intervention of this river.

112 Sustainable Development Goals: the global context defining the agenda for government, business and academia

113 Can the Agenda 2030 and the Sustainable Development Goals be the drivers to change the world?

E. Giovannini, ASViS

114 How the SDGs are being addressed in Horizon 2020

M. Tamborra, European Commission - DG Research and Innovation

115 Examples of EU projects related to SDGs

M. Recchiuti, European Commission - EASME

116 Why SDGs are relevant for a large enterprise

A. Valcaíla, ENEL

117 Conclusions

E. Tonda, UN Environment / Division of Technology, Industry and Economics (DTIE)

118 Questions and answers

119 Rethinking Atmospheric Mercury Chemistry

M. Gustin, University of Nevada, Reno / Natural Resources and Environmental Science

Mercury (Hg) is considered a global pollutant. This is because it has a long atmospheric residence time. Because of the continued and increasing emissions of this pollutant to the atmosphere associated with anthropogenic activities, and the fact that once released from a geologic repository an atom of Hg may be potentially bioavailable for thousands of years, the Minamata Convention was developed and has come into force. This global treaty focuses on protecting human health and the environment from the adverse effects of mercury. There are 3 general forms in the atmosphere- gaseous elemental Hg, gaseous oxidized Hg (Hg(II) or Hg(II) compounds), and that bond to particles. Gaseous elemental Hg can be transformed to gaseous oxidized Hg (GOM) by a variety of atmospheric oxidants. Once generated, GOM is readily deposited to ecosystems. Understanding the chemistry of GOM is important for predicting deposition velocities, availability in ecosystems, and potential for conversion to methylmercury. Methylmercury is a stable neurotoxin and is bio-accumulated in ecosystems. Recent work using cation exchange membranes in the University of Nevada Reno –Reactive Mercury Active System (UNR-RMAS), and an air Hg calibrator system (Utah State University) have demonstrated that the standard measurement method for GOM –collection on a KC1 denuder- results in underestimation of GOM concentrations by 2-13 times. In addition, thermal desorption profiles of GOM compounds collected using nylon membranes indicate that different chemical forms exist in the atmosphere. Data collected in urban areas, in the marine boundary layer, and at high elevation indicate that GOM compounds present are influenced by oxidants present in the air.
Different oxidized forms are produced in the free troposphere, marine boundary layer, and due to local oxidants in urban areas. Understanding atmospheric chemistry of GOM is important for developing instruments that will accurately measure GOM, and helping guide policymakers in developing solutions for reducing Hg emissions and contamination of ecosystems.

120 Evaluating spatial dynamics and species variation on mercury and selenium molar ratios in Northeast Atlantic marine fish communities

A. M. Azad, NIFES / Contaminants and biohazards; S. Frantzen, B.M. Nilsen, A. Dunker, National Institute of Nutrition and Seafood Research / Contaminants and biohazards; L. Madsen, National Institute of Nutrition and Seafood Research / Seafood; M.S. Bank, Institute of Marine Research / Contaminants and biohazards; A. Maage, NIFES / Monitoring Programme

Seafood is the main dietary source of methylmercury (MeHg) exposure for humans and MeHg is a primary contaminant of concern for seafood consumption advisories. Co-occurrence of the Selenium (Se) and mercury (Hg) in seafood directly affect their bioavailability and toxicity. The protective and antagonistic effect of Se on Hg toxicity has been reviewed recently (DGM) and physico-chemical processes as well as biological DGM production. Contrary to MeHg, selenium (Se) does not seem to be involved in mercury methylation in seawater under the absence of Fe or N limitation. Under P-limitation, the activity of DGM transformations are probably not metabolically dependent, as most of these reactions occur in the presence of additional substrates containing elevated concentrations of these two contaminant metals. Our data provide evidence of a wedge-shaped cluster for the relationship between Se and percent MeHg in bulk sediment and biofilm, suggesting that at high concentrations, percent MeHg in bulk sediment and biofilm are reduced. In craneflies and spiders, we find a negative correlation between Se concentration and both absolute MeHg concentrations and percent MeHg. These results suggest that Se inhibition of MeHg accumulation might occur both at the microbial and macroinvertebrate levels.

Constraining Uncertainties in the Global Mass Balance of Mercury Using Observations and a Bayesian approach

S. Mustafa, IIT Hyderabad; A. Qureshi, IIT Hyderabad / Civil Engineering

Uncertainties in global mass balance of mercury are constrained in this work using all the currently available observations of mercury species in the global environment, and a previously published multimedia model for mercury, UNEP-WCMC. Reducing Hg emissions and contamination of ecosystems.

Bioavailability and realistic risk assessment of organic
125 Anisotropic exchange kinetics of organic contaminants with passive samplers in different sediment: is multiple-thickness passive sampling the better alternative? D. Gilbert, NGI / Environmental Technology; A. M. Oen, Norwegian Geotechnical Inst. / Environmental Technology; N. Berrojalbiz, Norwegian Geotechnical Institute / Environmental Technology; H. Arp, NGI / Environmental Technology Passive sampling with thin polymer sheets is increasingly recognized as a superior release–retrieval tool for the fast and noninvasive monitoring of nonpolar organic chemicals in sediment porewater. For deducing true freely dissolved concentrations in the aqueous phase from measured polymer concentrations, the compounds are required to reach thermodynamic equilibrium between the polymer and the water phase. However, for in-situ deployment in stagnant sediment equilibrium times are beyond practical time scales. The spiking of passive samplers with performance reference compounds (PRCs) has therefore been introduced as a way to deduce equilibrium concentrations from the release of PRCs over the deployment period. This approach relies on the assumption of isotropic exchange kinetics between the uptake of the native compounds into the polymer and the release of spiked PRCs from the polymer. Our aim was to test whether this assumption is valid in stagnant sediments in in-situ and ex-situ conditions, considering different types of sediment and PRC and PRC concentrations. For the field study, we immersed low-density polyethylene (PE) and silicone thin sheet passive samplers of multiple thicknesses and spiked with PRCs for 5 months into contaminated sediment in the Oslo harbour. For the ex-situ study, Oslo harbour sediment and Horten harbour sediment was incubated with PRC-spiked PE under stagnant conditions at room temperature in the laboratory and samples were taken at various time points. From the PRC depletion field data, sediment porewater concentrations were modelled using the Fernandez-one-dimensional-diffusion model. In the additional field equilibrium concentrations were modelled using a multiple thickness one-dimensional diffusion model. The ex-situ uptake and release data were modelled with a one-dimensional diffusion model (uptake) and a simple exponential one-component model (release). The results showed that both in-situ and ex-situ data for uptake and release kinetics were not identical. In addition, the ex-situ experiment revealed that PRC release kinetics is also dependent on the initial PRC spiking concentration. In conclusion, the data question the usefulness of PRCs for passive sampling in sediment, as the use of polymers of multiple thicknesses can produce results that are free from biases caused by anisotropic exchange kinetics.

126 Sediment toxicity of chlorpyrifos: whole sediment bioassay vs. silicon disc passive dosing K. Walker, University of Amsterdam / IBED-ELD; N. Wieringa, University of Amsterdam/IBED Institute / FAME; M. de Baat, M. Kraak, University of Amsterdam / IBED-ELD; J. Parsons, University of Amsterdam / IBED-ELD; S. Droge, University of Amsterdam/IBED Institute / IBED Realistic risk assessment of sediments polluted with organic contaminants is much more complex than tests with water samples. Physical and biological processes as well as contaminant bioavailability, may strongly influence the adverse effects on test organisms in whole sediment testing. The current work is the first study of a series of studies for our group on whole sediment-equilibrated silicon rubber (ESR) which allow for a major simplification of the assessment of the overall impact of organic contaminants in sediment. The aim of the current study was to demonstrate that ESR can transfer the chemical activity of the insecticide chlorpyrifos from spiked sediment to aquatic bioassay with ESR as a passive dosing material. The effect level of chlorpyrifos in a 28d whole sediment bioassay was compared to effect levels observed in a 4d ESR passive dosing test using first instar larvae of the midge Chironomus riparius. Additional sampling with polyacrylate solid phase microextraction (SPME) fibers in both sediment and ESR dosed water was used to align the bioavailable concentrations in both tests designs. The ESR samplers accumulated chlorpyrifos up to 12% of the total spiked chlorpyrifos amount within 1 month. SPME samplers in sediment had 1-3x lower concentrations than SPME equilibrated with ESR. Thus, the chemical activity in sediment as well as that released from the ESR in water were comparable within a factor of 3. The insecticide chlorpyrifos showed only slightly more toxic effect levels in a 28d whole sediment test than in the 4d ESR dosing assay. Bioavailable concentrations in SPME samples in both assays indicated lethally toxic freely dissolved concentrations in the range of 0.02 – 0.1 µg/kg d.m. This study suggests that the 4d ESR dosing assay with sensitive first instar midge larvae provides valuable and realistic insight in the toxic potency of insecticided contaminated sediment comparable to much more elaborate 28d whole sediment tests. Also, at lowest tested toxic insecticide levels, concentrations in SPME extracts were close to detection limits, so accurate measurements of safe bioavailable chlorpyrifos concentrations via SPME becomes problematic. This suggests that ESR dosing assays and chronic whole sediment studies could be used more effectively to demonstrate specific pollutant toxicity than chemical analysis of realistic sediment exposure levels.

127 Implementing desorption extraction methods into bioavailability-oriented bioremediation R. Posada, IRNAS CSIC / Agroquimica y Conservacion del Suelo; J. Garcia, Instituto de Recursos Naturales y Agrobiologia de Sevilla CSIC; M. Cantos, IRNAS CSIC; J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiologia / Agroquimica y Conservacion del Suelo Regulators are starting to consider bioavailability within retrospective risk assessment frameworks for organic chemicals, however, implementation is not straightforward because the development of bioavailability science have not always been translated into ready-to-use approaches for regulators. Possible pathways for translating bioavailability science into regulation of organic chemicals have recently been identified (Environ. Sci. Technol. 49:10255-10264, 2015). A simplified approach was proposed in which the assessments of soil/sediment and their chemicals should be based on two measurable values: the total extractable concentration and the bioavailable concentration as measured with robust and reproducible chemical and/or biological methods. One of the chemical methods which has been proposed to measure bioavailability of hydrophobic chemicals (HOCs) such as PAHs is the desorption extraction with Tenax during 20 h (ISO 17402) (Environ. Toxicol. Chem. 20:706–711, 2001; Integr Environ Assess Manag. 11:208–220, 2015). Understanding the role of bioavailability in the biodegradation of chemicals is relevant not only for retroactively contaminated land management but also prospective risk assessment applied in the approval and regulation of organic chemicals. With the aim of providing pathways for implementation into regulatory contexts, we carried out desorption extraction measurements with Tenax in a greenhouse experiment in which different strategies (use of soil/sediment and PAHs, gradient of spiked soil/sediment) were used. The very low soil/sediment concentrations in the bioavailable fraction is of great interest because the bioavailability is also dependent on the initial PRC spiking concentration. Therefore, the effect of different PRC spiking concentrations on the bioavailability of PAHs was also studied. In conclusion, the PAHs degradation in soil slurries. In conclusion, Tenax extraction during 20 h resulted a reliable and robust method to determine bioavailable concentrations in a wide set of operational conditions ranging from a different time scale to dissimilar treatments (planting, biosurfactant application, etc.).

128 Prediction of very slow biodegradation of PAHs in soil and validation in a pilot of 25 years R. Rietra, Akateria and Wageningen University / sustainable soil management; J. Harmsen, Wageningen Environmental Research / CALM Biodegradation of polycyclic aromatic hydrocarbons (PAHs) and mineral has been followed during periods up to 25 years. Biodegradation took place on real scale fields (six landfarms and one depot) within the Netherlands. On these fields dredged sediments were used for bioremediation. PAHs were present in concentrations above 550 mg/kg d.m. (Dutch list). The objective of the investigation was to find experimental prove on the existence of long term biodegradation in field conditions. The measured data showed continuation of PAH degradation and this could be distinguished in 1) fast degradation in the first year 2) slow degradation in the following 6 years and 3) very slow degradation for PAHs from 6 years until at least 25 years. Knowing the long time necessary for biodegradation, it will be necessary to supply regulators with data and prediction to convince them that biodegradation will be a safe option to remediate the contaminated soil or sediment Bioavailability as measured with Tenax can be used to explain and predict the rate of biodegradation of PAHs. Three desorbing fractions can be measured. Tenax applied at 20°C gives the fast desorbing fraction which applied at 60°C gives the medium desorption fraction is measured. The last desorption fraction in the residue represents the very slow desorbing fraction. These are the same fractions as considered in the approach of Ortega-Calvo et al., (2015). In the soil, desorption makes the PAHs bioavailable and if conditions allow biodegradation (sufficient oxygen and water), this will occur. Using results measured in stored original sediment the different bioavailable fractions were measured and using a model with three first order derations (fast, slow and very slow) the really observed degradation curve could be predicted. Moreover, the fractions measured in present soils, shows that biodegradation will continue, however with a very small slow rate. Experiments applied in the nineties of last century had already shown that risks measured with bioassays were already not measurable after 6 years of landfarming. After 25 years the PAHs concentrations were 10 mg/kg d.m. or lower which made the soil reusable within the Dutch legislation.

129 Linking bioavailability of complex mixture to toxicity changes to assess recovery of contaminated soils S. Fernandez, School of Water, Energy and Environment, Cranfield Water Science Institute / School of Water, Energy and Environment, Cranfield Water Science Institute; I.G. Negrin, L. Claveau, Cranfield University / School of Water Energy and Environment Cranfield Water Science Institute; B. Snapir, Cranfield University / School of Water Energy and Environment Cranfield Agrifood; P. Campo Moreno, Cranfield University / Cranfield Water Science Institute; F. Coulon, Cranfield University / School of Water Energy and Environment Cranfield Water Science Institute A six-month laboratory scale experiment was carried out to assess the effect of biochar and compost amendment on the behaviour and toxicity of tar mixtures in...
130 Impact of Biochar Additions to Soil on Contaminant Sorption and Plant Bioavailability

W.J. Doucette, Utah State University / Utah Water Research Laboratory; J. Finningski, D. McAvoy, Utah State University

Reclaimed water is increasingly used in arid and semi-arid regions for irrigation. Contaminants in the reclaimed water, (e.g. pharmaceuticals and personal care products (PPCPs) and metals) could accumulate in exposed crops. Biochar is a potentially cost-effective soil amendment and contaminant sorbent that could reduce the plant bioavailability of reclaimed water associated contaminants. Biochar is biologically inert and the changes that have undergone pyrolysis (decomposition at high temperatures with no oxygen) underlie the highest percentage germination for both soils across all seed types. Similarly, the earthworms assay showed there was significantly greater survival rate at the end of the experiment compared to the onset. The biochar treatment resulted in a lower survival counts compared with compost treatment, with the non-treated samples having the lowest results. Preliminary results suggest that addition of compost and biochar accelerated the degradation rate of hydrocarbons compound and contributed in reducing toxicity of the soils. The degradation of PAHs and re-distribution of HMs will be evaluated with a multivariate analysis; data will be explored to highlight associations between contaminant’s concentration (reduction) and its influence on biological properties and toxicological responses in mixed contaminated soils.

131 LCIA method developments in a global perspective: Status and outlook (II)

132 A midpoint indicator for freshwater resources


Freshwater resource has been recognized as being a safeguard subject within the Agenda 21 (Water Management / Water policy) and the upcoming Water Framework Directive. Besides depletion also long-term pollution threatens the sustainability of freshwater resources, but currently no LCIA model links emissions to potential damage on freshwater as a natural resource. This study proposes a characterisation model to assess the potential impacts on freshwater resources generated by persistent changes in water quality caused by chemical emissions. The relevance of this new approach regarding the methodological issues of long-term (toxic) impacts is also discussed. As recommended in the WULCA freshwater resources framework the concept of recovery period is used: when the recovery period lasts longer than a given period of time, potential impacts to freshwater resources (i.e. affecting freshwater availability for future generations) need to be considered. Based on literature review, we set the time period at 100 years, which requires a dynamic fate modeling approach. The new dynamic fate guidance has the potential to harmonize current and future methods under a unique framework and to enhance the environmental relevance of the use water impact category in LCA.
quantify potential water consumption impacts on freshwater ecosystems. In existing mechanistic models, mostly based on species-discharge and species-area relationships, ecological requirements are not taken into account. This implies considering equal response to stress for different taxa, overlooking the relationships between species and their habitat, along with other aspects of biodiversity (e.g. abundance). In this study we want to show the importance of habitat modelling to describe the impact pathway of water consumption on ecosystem quality. We propose a new focus on freshwater habitat and discuss the applicability at the regional and global scale. Water consumption may alter stream discharge and other related physical variables. Habitat suitability equations can be used to quantify physical habitat availability for freshwater species in Weighted Usable Area (WUA). Starting from WUA equations, a Habitat Characterization Potential (HCP) model for river fish species is developed and invertebrates is proposed and applied in France at Q50 (wet season) and Q90 (dry season) flows. HCP represents the change of available habitat area deriving from river discharge alteration. At the river reach scale, HCPs from different taxa have been aggregated under different perspectives in order to test the results’ sensitivity to negative and positive effects of hydrological alteration. A spatial aggregation has been also performed on the raw HCPs and sub-watershed. Subsequently, the global HCP model’s applicability has been discussed. HCP is highly correlated with river size. The aggregation at reach scale is driven by specific taxa and by positive HCP scores (habitat loss). The result of the aggregation at watershed is consistent with existing evaluations of hydromorphological pressures in Europe. The main challenge in applying HCP globally is due to hydrological and hydraulic data availability. This is a major gap to be filled in the future. As future steps to improve the present work could be the development of HCPs for extra-European and extra-European species habitat preferences. The proposed model is a promising effect factor for mechanistic impact characterisation which should be integrated with fate factor models describing hydrological alteration at a comparable spatial resolution. Since habitat models are based on species abundance, HCP represents the first step towards developing biodiversity damage indicators complementary to species loss.

Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (III)

134 The use of dynamic stock model to the definition of characterisation factors for biotic resources depletion

A. Hélias, Montpellier SupAgro / LBE ELSA; J. Langlois, Université Paul-Valéry Montpellier 3 / CEPE UMR CNRS Université de Montpellier Université Paul-Valéry Montpellier EPHE Université PaulValéry Montpellier Montpellier cedex France; P. Fréon, IRD, emeritus scientist

Biotic natural resources have received little attention by the LCA community and this tempers the use of LCA for fish based food and feed products. Current LCA methods do not assess the impact of biotic depletion on biotic stocks very well. The dynamic of biotic stocks (i.e. population) is a well-studied topic in theoretical ecology and it is commonly used for fish stocks management. The main of the present work is the use of this knowledge to assess biotic resources depletion in LCA. This is illustrated by the definition of characterisation factors (CF) for fish stocks depletion. The relationship between inventory and impact is often determined by the marginal efficiency where the CF is used for quantifying a marginal change in impact according to a marginal change in inventory. Here, the Depleted Stock Fraction (DSF) is considered to be the assessed impact while the elementary flow of the inventory is a mass of fish removed from the biomass stock. The marginal approach is applied to the Schaefer model, a commonly used model in fisheries representing the dynamics of the biotic stocks. It combines catches, current biomass and maximum intrinsic growth rates of the stock (population). To determine these parameters for most of the world fisheries, catch time series were used for species of FAO Global Fishery and Aquaculture Statistics. This allows assessing all fisheries of the world in the LCA framework with a midpoint biotic resource depletion impact. To our knowledge, this work is one of the first assessments of biotic depletion in LCA, based on a model of population dynamics. We are confident this will bring improvements to the LCA of fish-based products, allowing for the comparison of different fishery alternatives with respect to the use of marine biotic resources. One of the extensions of this present work could be the definition of CFs for terrestrial biotic resources where similar dynamic stock models are used. This advocates the use of a similar approach based on population model dynamics for both terrestrial and marine biotic resources.

135 Accounting for soil quality effects of agricultural land management in LCA

B. Lieselot, R.A. Alvarenga, Ghent University / Department of Sustainable Organic Chemistry and Technology; V. Van Linden, Flanders research institute for agriculture, horticulture and food / Technology and Food Science Unit; I. Roldán-Ruiz, Flanders research institution for agriculture, fisheries and food; J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology

The growing demand for food and feed has put a pressure on the agricultural sector, which resulted in agricultural intensification. This entails many adverse environmental impacts and takes a huge toll on land resources; which can result in land degradation. Especially farm management can affect soil quality (e.g. soil organic carbon, SOC) by for instance the choice of crop rotations. The agricultural sector is therefore forced into a more sustainable approach. To assess the environmental sustainability, life cycle analysis (LCA) is a powerful tool. As soil quality is an inherent aspect of agricultural sustainability, life cycle impact assessment (LCIA) methods should account for the effect of agricultural land management on soil quality. Despite a lot of efforts that have already been made, there are still several research needs on the integration of soil quality effects in LCIA methods. Ideally, inventory data are translated into the effect on the environment by indicators moving along the cause-effect chain from mid- to endpoint towards an area of protection (AoP). Although soil quality changes are often related to the AoP ecosystem health, we focus on the AoP natural resources as we refer to the impact of land management on soil by the long-term ability to produce biomass. To improve the usefulness in the agricultural sector, different land use intensities should be distinguished. We therefore introduce three interdependent LCIA indicators. At early midpoint, SOC changes (SOC1, indicator 1) are used to indicate the long-term effect of agricultural land use on soil. This can result in biomass productivity losses (BPL, indicator 2). At endpoint, we propose additional land requirements (ALR, indicator 3) as indicator, which corresponds to the area needed to produce the yield that has been lost. To calculate characterization factors (CFs), we chose as reference situation the highest achievable SOC stock and yield, which are calculated for each initial soil quality stock. The models RothC and EU-Rotate, N are used to quantify SOC stocks and yields, respectively. CFs are developed for several rotation systems in Flanders. Though, the elaborated framework is generally applicable and allows the calculation of CFs for other regions. Thanks to the use of an achievable reference situation and a distinction between land management strategies (good, bad and standard practices), the indicators can be a useful tool to strive for a more sustainable agriculture.

136 Poster spotlight: MO093, MO094, MO106
performed in a first stage and then in the next step studies are conducted directly in the natural environment. In our group, we proposed a workflow using the combination of HRMS and processing software for evaluating the phototransformation of pharmaceuticals on a single compound basis under simulated and real environmental conditions. In contrast to this compound-by-compound approach, in the new approach presented here, degradation was not assessed for a single compound but instead a cocktail of human drugs was subject to the transformation process. Following the identification of photo-TPs, a list of suspect TPs was created and used to screen them in SPE-concentrated river water samples. For the generation of photo-TPs, reconstituted surface water was spiked with a cocktail of 34 pharmaceuticals at concentrations of 10 μg/L and exposed to artificial light in a sunlight simulator. UPLC-ESI-MS (MS/MS) was used to identify the photo-TPs. Subsequently, surface water samples originating from rivers were screened for their presence. For the enrichment of the potential photo-TPs, water samples were preconcentrated on four SPE cartridges connected in series and then analyzed using the same system mentioned above. With this methodology more than 30 photo-TPs were detected in the irradiated reactor samples. As of the time of submission of this abstract, the identification and some of the photo-TPs was still underway. Several photo-TPs of our database were detected in the extracts of the surface water samples. Thus this approach highlights that UPLC–HRMS is a powerful tool for qualitative analysis, allowing the search for photo-TPs. With the detection of some photo-TPs we have provided evidence for photolysis and thus underpinning the importance of natural attenuation processes in rivers.

139 Degradation of a polymer probe exposed to different wastewater environments: Linking chemical transformations and potential microbial consumers
A.A. Berdella, CSIC - Spanish National Research Council / Environmental Chemistry, M. Vila-Costa, B. Zonja, IDAEA-CSIC / Environmental Chemistry, N. Montemurro, IDAEA CSIC Barcelona / Dipartimento di scienze agroambientali e territoriali; S. Pérez, A. Martinez-Varela, IDAEA CSIC / Environmental Chemistry, D. Rivas, IDAEA CSIC / Environmental Chemistry; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry

The objective of the present contribution was to link the chemical transformations observed in a polymer probe exposed to the different aquatic environments found in a WWTP with the microbiological communities present in situ. Phylogenetic composition of free living bacteria was compared to polymer-attached microbial communities. Specifically, chemical degradation and microbial community characterization was carried out in the influent flow (IN), in the secondary aeration tanks (HILIC) and in the anaerobic part of the WWTP. Several photo-TPs of our database were detected in the extracts of the surface water samples. Thus this approach highlights that UPLC–HRMS is a powerful tool for qualitative analysis, allowing the search for photo-TPs. With the detection of some photo-TPs we have provided evidence for photolysis and thus underpinning the importance of natural attenuation processes in rivers.

141 Halogenated methanesulfonic acids in drinking water - Identification, standard synthesis, and analysis
D. Zahn, Hochschule Fresenius / Chemistry and Biology; A. Harloff, Hochschule Fresenius, University of Applied Sciences; R. Meusinger, TU Darmstadt / Chemistry; T. Frömöl, Hochschule Fresenius, University of Applied Sciences; T.P. Knepper, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology Persistent, bioaccumulative, and toxic (PBT) substances have been monitored since the 1960s. PBT substances are usually not well water soluble and tend to adsorb to sludge, soil and other particular matter, and thus spread slowly in the environment. However, as a consequence of their high environmental stability, they can eventually reach even remote areas like the arctic, and pose a threat to apex predators due to their ability to accumulate in the food chain. Persistent, mobile, and toxic (PMT) environmental contaminants, however, do not accumulate in the food chain, but are much more mobile in aquatic environments, and thus, they spread fast throughout the environment. Although the problem of PBTs was not considered at that time, the PMT phenomenon has become more important in recent years due to increased environmental awareness. Therefore, analytical methods for the determination of PBT substances are needed to identify and monitor these compounds in environmental samples. One commonly used analytical technique for the determination of PBT substances is high-performance liquid chromatography with ultraviolet detection (HPLC-UV). However, this technique is limited in its ability to detect low concentrations of PBT substances. Therefore, more sensitive and specific methods are needed for the detection of PBT substances in environmental samples. One promising method is high-resolution mass spectrometry (HRMS) which provides high resolution and mass accuracy. HRMS is a powerful tool for qualitative analysis, – however the results are often difficult to interpret due to the complexity of environmental samples. To overcome this limitation, many researchers have developed different strategies to simplify the sample matrix. These strategies include solid-phase extraction (SPE) with different sorbents such as C18 or C8, or liquid-liquid extraction (LLE). However, these strategies are not always successful in removing all matrix interfering compounds from the sample matrix. Therefore, a new approach was developed to simplify the sample matrix and enhance the detection sensitivity of PBT substances. This approach is based on the use of a combination of SPE and LLE. The SPE step is used to remove large interfering compounds from the sample matrix, while the LLE step is used to extract the PBT substances from the sample matrix. This approach was tested in four WWTPs by exposing the polymer probes in situ at the outlet of the WWTPs. The resulting polymer probes were analyzed using HRMS to determine the identity and concentration of PBT substances. The results showed that this approach is effective in removing interfering compounds and enhancing the detection sensitivity of PBT substances. Therefore, this approach is a promising method for the detection of PBT substances in environmental samples.
European Commission Joint Research Centre / Bioeconomy unit; A. Laurent, DTU / Division for Quantitative Sustainability Assessment DTU Management Engineering

The European Inventory of Existing Commercial chemical Substances (EINECS) lists over 100,000 chemical substances used on the market. Over 16,000 chemical substances have been registered in REACH since 2008. In comparison, only ca. 3,000 substances were in use in the life cycle impact assessment (LCIA) to express their potential toxic impact on human health (cancer and non-cancer effects) and freshwater ecosystems. Because of human activities, those pollutants may enter the environment in several different ways: they are emitted to air from the combustion of materials, released through wastewater from industries and households, applied to soils together with manure and pesticides, etc. Combined with the intrinsic variability of release data, the sheer number of substances and the large variety of emission sources are challenges that one needs to overcome to quantify the overall toxic impacts of a country. Here, we therefore propose an updated methodology to build national inventories of toxic emissions in EU Member States in 2000-2014. The framework builds on earlier works and differentiates environmental compartments (air, water and soil) as well as anthropogenic sources (industries, households, manure and pesticides application on agricultural soils). It relies on existing and publicly available data, and extrapolation techniques are developed and used to fill in the gaps across countries in the entire period 2000-2014. The resulting harmonized inventories cover more than 500 substances, both including organic and inorganics such as persistent organic pollutants and heavy metals. Although still limited in substance coverage, it is thus possible to analyze the contribution of each substance and anthropogenic source to the toxic impacts on human health (human toxicity) and freshwater ecosystems (freshwater ecotoxicity), using LCIA methods such as the consensus model USEtox.

144 Combining economic modelling and LCA to assess regional policies: key learning points from a case study on the French forestry sector
T.B. Beusschess, INRA; E. Lloisie, Irstea; S. Caurla, INRA

Economic modelling is increasingly used in Life Cycle Assessment (LCA) to perform consequential LCA for the environmental assessment of product and services. Economic models can also provide significant enhancements for assessing the effects of regional policies, such as in territorial LCA approaches. Among them, equilibrium models appear as a good compromise to assess both socio-economic and environmental impacts of regional policies in an exhaustive and representative way. However, there are still some bottlenecks when trying to combine both approaches in practice. For instance, the levels of system aggregation and discrepancy between the two models require additional geographical developments to ensure a consistent combination while limiting the time spent to collect data. This talk aims at providing insights on the combination of a partial equilibrium model, the French Forest Sector Model (FBSM), and LCA to assess the eco-efficiency of two regional policies supporting local wood industries in the French East Region. Two approaches will be used to combine economic models with LCA: i) a Life Cycle Inventory (LCI), i.e. i) Extended Environmental Input Output modelling; and ii) a method based of MFA (Material Flow Analysis) and process-based LCA. Eco-efficiency ratios based on economic and environmental impacts allow identifying scenarios with best environmental performances. In addition, this combination allows considering supply and demand dynamics, and thus the socio-economic effects of a decision. Using two different approaches, we are able to compare strengths and weaknesses of both types of combinations and discuss them considering policy assessment results, system representation and system boundaries. Thus, our work provides both insights on down-to-ground policy analysis and methodological developments on combining economic modelling with LCA. Here, economic modelling outputs are used as LCA inputs but more integrated modelling could be performed for completeness and optimization purposes. Perspectives on a stronger coupling will also be discussed.

145 A regional life cycle approach for assessing the climate change mitigation potential of biobased activities
S. O’Keefe, Helmholtz centre for environmental research - UFZ / BEN; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; U. Franko, Helmholtz Centre for Environmental Research, UFZ / Department of Soil Physics; D. Thraen, Helmholtz Centre for Environmental Research - UFZ/ Deutsches Biomasseforschungszentrum gemeinnützige GmbH, DBFZ / BEN

Key words: Regional, spatial, biobased economy, GHG While traditional life cycle assessment is a powerful tool for spatial applications, it is limited. With the ever increasing drive towards regional biobased circular economies, as a means of ensuring future climate change mitigation, there is a need to develop a regional and spatially representative life cycle assessments of biobased systems and bioeconomy regions. “RELCA”, a Regional Life cycle inventory approach, was developed to assess the regional and spatial variation in the environmental performance of bioenergy production within a focus region. Through the use of catchment delineation, conventional geographical modelling is combined with life cycle software to assess the potential environmental burdens of regional bioenergy configurations (i.e. bioenergy plants and their biomass catchments). RELCA was used to assess the climate mitigation potential of biodiesel, for the region of Central Germany. With this approach we showed, for the focus region, that the mitigation potential changed between the different biodiesel configurations, due to their location within the region. When compared to a fossil diesel comparator (83.8 CO2eq./MJ), the climate change mitigation potential of the regional biodiesel ranged between 53%-62%. When the results were compared to the typical RED (Renewable Energy Directive) values, a 13-31% greater mitigation potential than the RED was observed. The latter, indicating that regional variability cannot be captured with a simple regional average value or default value. Additionally, scenarios were used to test the mitigation potential of reduced nitrogen fertiliser application during the biomass production phase. The results of the scenarios indicated that while reduced nitrogen fertiliser led to emission reduction per hectare, the greater land area input required to meet the demand of the biodiesel plants, led to an increase in emissions ranging from 1.14-5.71 g CO2eq./MJ biodiesel. Thus, highlighting that assessments of biobased systems should consider configurations of biomass and conversion plants in order to determine appropriate mitigation strategies. Therefore, the ability to account for the territorial and geographical characteristics found within a region, using life cycle approaches, is important to support more sustainable regional resource management.

146 LCA_WIND_DK: temporally, geographically and technologically-sensitive life cycle inventories for the Danish wind turbine fleet

The environmental performance of a wind turbine is usually calculated as the ratio of the life cycle impacts occurring during the lifetime of the turbine to the electricity it produces during the use phase. The modelling of the life cycle inventory in each phase should ideally cover the temporal, geographical and technological dimensions of the wind turbine system under study. Assumptions are commonly used to simplify and handle variable aspects of the inventory. While this approach provides generic, one-size-fit-all inventories, it may disregard important characteristics of the wind turbine leading to biased end-results. As these assumptions are prone to differ from one study to another, the results become hardly comparable. With more than 1,500 wind turbine models on the market and a high variability of sites and manufacture periods of the different installations, it makes the environmental assessment of wind turbines a daunting task. The Danish Wind Life Cycle Assessment model for Denmark, LCA_WIND_DK, is an approach aiming to provide the environmental footprint of Danish wind turbines based on systematic individual cradle-to-grave life cycle inventories using manufacturer’s data. The temporal context is considered through the evolution of the electricity mix used for manufacturing wind turbines as well as the evolution of recycled content in materials over time. The spatial dimension is also accounted with geographical parameters determining the amount of material required, such as the distance from shore and sea depth for offshore installations. Additionally, the supply chain is adapted to select the relevant origin of the material and energy suppliers. Finally, the approach considers the registered electricity production for past and present wind turbines and assesses the future production from site-specific weather re-analysis data and power curves. Denmark, where wind power contributed to 45% of the gross annual electricity production in 2016, is a prominent choice to demonstrate the benefits of such comprehensive modelling based on spatial, technological and site specific LCAs. The approach generates a life cycle assessment for each of the 11,000 wind turbines that compose the Danish national fleet over the 1980-2030 period. The results, through the on-line tool, are showcased as a map, where the individual performance of each of the past, present and future wind turbines can be consulted, as well as the performance of the whole fleet at a given year.

147 Assessing environmental impacts of individual households: A large-scale bottom-up approach
A. Froemelt, ETH Zurich; R. Buffat, ETH Zurich / Institute of Cartography and Geoinformation; N. Heeren, S. Hallweg, ETH Zurich / Institute of Environmental Engineering

Besides governmental consumption, household consumption is the main driver of economy, and is thus ultimately responsible for the environmental impacts that occur over the whole life cycle of products and services, installation and installation. Therefore, assessing environmental footprints of households is an important basis to identify environmental policies. This study aimed to develop a comprehensive regionalized bottom-up model for Switzerland that is able to assess the environmental impacts induced by individual households. The purpose of this model is to provide a virtual platform for detailed scenario analysis which shall support effective political decision making on different scales. Three existing bottom-up models were merged: a building stock energy model, an agent-based transport simulation and a household consumption model. All of them were tested and evaluated beforehand. The physically-based building energy model establishes
simplified energy balances for each residential building and spatially and temporally resolved climate data, building characteristics and 3D-geometries. It provides estimates of space heating, hot water and electricity demand for each Swiss household. The mobility sub-model builds upon the results of an agent-based traffic simulation framework which was applied to Switzerland and reproduces mobility patterns of Swiss inhabitants in space and time. The third sub-model provides a data-driven approach and enables the quantification of consumption of food, consumables, and other goods and services for each Swiss household by means of data mining techniques. Linking these sub-models with environmental background data allowed for computing an environmental profile for each household in Switzerland. The application of this model to the current situation of Switzerland reveals interesting differences between individual households, district and region and different use scenarios. By covering the variability of household behavior and quantifying the demands and environmental footprints of households within a certain area, the model delivers important insights for local policymakers to derive targeted environmental strategies tailored to the specific problems and household types in a region. Furthermore, the high resolution of all three sub-models permits testing of policies and in-depth analyses of scenarios, ranging from household refurbishment programs to future mobility solutions such as autonomous vehicle systems.

148 Poster spotlight: MO109, MO110, MO113

Mechanistic effect modeling for risk assessment: applications, use in a regulatory context and future directions

149 Modelling ecological scenarios for the assessment of chemical effects on stream communities

A. Gergs, Bayer AG - Crop Science Division / Department of Environmental, Social and Spatial Change; S. Classen, K. Ladermann, Research Institute gaiac; T. Strauss, M. Hammers-Wirtz, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment

The ecological risk assessment of chemicals (ERA) aims at quantifying the likelihood of adverse ecological effects posed on populations and the communities they comprise. Effects caused by the exposure of organisms to chemicals can however to a great extent depend on environmental scenarios as well on the states, behaviours and interactions of organisms with consequences for individual life history, population responses and community dynamics. In this regard, our major objective is to suggest how to model stream ecological scenarios for ERA. We suggest to employ ecological classifications as defined within the Water Framework Directive. Here, the ecological scenario is a virtual representation of an ecosystem, which involves both abiotic components (habitat scenario) and biotic components (the functional and life history scenario). Technically, we integrate spatial explicit habitat information in form of raster maps, temporal information on abiotic factors like temperature and chemical exposure, functional trait data bases, dynamic energy budget models and process based effect models to simulate macroinvertebrate and fish assemblage dynamics. In model applications, we explore to what extent the ecological scenario will affect the adverse outcome of chemical exposure.

150 Robust implementation of TKTD models with Bayesian inference

V. Baudrot, Université Lyon 1; S. Charles, University Lyon 1 / Laboratory of Biometry and Evolutionary Biology

The application of toxicokinetic-toxicodynamic (TKTD) modeling proved to be of particular interest in strengthening the Environmental Risk Assessment (ERA) of chemicals compounds (e.g., REACH dossier accounting for toxicity of industrial discharge, evaluation of impacts of Plant Protection Products (PPPs), ...). TKTD models describe the time-course of processes leading to toxicity at the level of organisms. These models include all mechanisms from the toxicokinetics part describing the compound fate from external concentration to internal kinetics (e.g., exposure, uptake, elimination, biotransformation, internal distribution), and translate the internal concentration into toxicodynamics covering alteration of cells and organs functioning that can eventually lead to a toxic effect at the organism level (e.g., mortality, reduced reproduction, abnormal behavior) then affecting the population dynamic. For survival analysis of organisms in response to a chemical stress, the Generation-Specific Threshold model of Survival (GUTS) is today recognized as a suitable and powerful TKTD framework incorporating two complementary death mechanisms: Stochastic Death (GUTS-SD) and Individual Tolerance (GUTS-IT), from which a large range of existing models can be derived. Under governmental institutions as the OECD have acknowledge the necessity of TKTD models for ERA improvement, but while an integrative mathematical framework as GUTS offers an efficient theoretical approach, its practical use is challenging (from model implementation to parameter estimation), especially with time-variable exposure. The Bayesian approach has multiple advantages as (i) using all data provided by the experiments, (ii) taking into account the knowledge from experts and/or previous studies, (iii) being relevant for complex model with small dataset since there is no degree of freedom, and (iv) a clear handling of uncertainties by providing distributions of parameter posterior.nTo ease the access of Bayesian fitting of GUTS models based on ordinary differential equations, we compared several implementation of GUTS models with different R packages. To assess the suitability of these tools, we implemented two algorithms within two R packages with the core idea to be user friendly (e.g., using experiment design to define priors). A side result is to propose a step-by-step approach to perform Bayesian statistics in ecotoxicology.

151 Can TKTD-models describe and predict synergistic interactions in Chironomus riparius?

K. Dalhoff, University of Copenhagen / Department of Plant and Environmental Sciences; G. Bellijsa, European Food Safety Authority EFSAS; E. Neira, N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences

The azole fungicides propiconazole and prochloraz are known to enhance the toxicity of pyrethroid insecticides like α-cypermethrin during co-exposure. The development of these synergistic actions in the waterfly Daphnia magna have recently been modelled using toxicokinetic (TK) and toxicodynamic (TD) models in order to describe the underlying mechanisms for the enhanced toxicity. The purpose of the current study was to predict the same for C. riparius TKTD-framework for synergistic interactions in D. magna can be applied to the midge larvae Chironomus riparius to describe development in survival rates and the underlying mechanisms over time when co-exposed to azole fungicides and pyrethroid insecticides. Toxicity of the individual compounds was tested using a pulsed concentration response design with an initial 24 hour exposure period followed by six days of recovery in clean medium. To assess the combined lethal effects on the azoles and α-cypermethrin were a range of tests conducted with co-exposure to 1, 3, 10, 30, or 100 µg L⁻¹ of propiconazole or prochloraz and 2.5, 5.0, or 10.0 µg L⁻¹ of α-cypermethrin. For the TK-modelling will uptake and elimination rates of the individual compounds in C. riparius be measured to parameterize the TK-model besides using the internal co-exposure scenario to test the observed synergies. We hypothesise that the synergistic interactions can be described and modelled by adding a synergy parameter “s” to the biotransformation rate constant for α-cypermethrin and that the value of this “s” parameter will depend on the azole exposure concentration. The preliminary results indicated time-dependent synergistic interactions in C. riparius as previously observed in D. magna, but also a higher sensitivity of C. riparius towards the fungicides with 168 h EC₅₀-values for the 24 h pulse exposure of 1.06 ± 0.27 and 0.28 ± 0.10 µg L⁻¹ for propiconazole and prochloroz, respectively. This is surprising as previous non-published data indicated that C. riparius has an approximately 10 fold faster initial elimination rate of the azoles compared to D. magna. We expect that our TKTD models will be able to explain these kinetic differences and how they relate to the observed toxicity. We furthermore hope that models can anticipate the fate of azole fungicides and pyrethroids exposed to azole and pyrethroid pulses with varying time intervals between the pulses.

152 Integration of temperature-dependent TKTD kinetics in individual-based population modelling - A case study with Chaoborus crystallinus

T. Strauss, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment

The toxicokinetic-toxicodynamic (TKTD) model framework GUTS is increasingly used and becoming the standard effect model in regulatory risk assessment. However, this model is mostly used without the temperature dependency of TKTD kinetics, and effect measurements are usually performed in the laboratory at 20°C. This approach is rather unrealistic, especially in outdoor scenarios with significantly different water temperatures over the year: On the one hand, in cases with low water temperatures during autumn and winter, the toxic effects can be reduced or delayed, while on the other hand, the degradation of the substance is often slowed down, which increases the exposure time. But also at higher temperatures than 20°C, increased toxic effects on organisms are to be expected. In this presentation, the influence of seasonal temperatures on toxicity at the population level is exemplarily examined. For this purpose, an individual-based population model for the phantom midge Chaoborus crystallinus is used. This has been extensively tested using outdoor aquatic mesocosm studies, and has been extended to the TKTD framework of GUTS, which has been then extended by a temperature dependency based on laboratory data. Temperature dependencies of lethal effects on C. crystallinus larvae exposed to the pesticide chlorpyrifos and the fate of chlorpyrifos were measured in the laboratory in the range of 4-20 °C. These data are used to parameterize the GUTS, and subsequently to simulate the population dynamics of Chaoborus under variable outdoor temperature conditions. The Chaoborus model was used with and without the implemented temperature dependency of the effect model to assess whether toxic effects on a Chaoborus population are increased or decreased depending on the temperature conditions. Therefore representative summer and winter exposure scenarios were selected.
Using temperature dependencies for the relevant biological and toxicological processes, this modelling approach allows a more realistic risk assessment of pesticides for populations in the field.

153 Assessing lethal and sublethal effects from time variable exposure for different life stages with the DEB model: an example for a Pythroid in rainbow trout E. Zimmer, IBACon GmbH; T. Preuss, Bayer Ag / Environmental Safety; S. Norman, RidgewayEco; B. Minten, ADAMA Deutschland GmbH; V. Ducrot, Bayer Ag / Environmental Safety Ecotoxicology

The study investigates effects of beta-cyfluthrin on juvenile rainbow trout (Oncorhynchus mykiss) using TK-TD modelling. As part of the risk assessment modelling is used as a supporting tool to back up the experimental results and as an investigation tool to better understand the mechanisms of effects of beta-cyfluthrin. Beta-cyfluthrin is acting as neurotoxicant in fish for which the severity of effect depends on the magnitude and duration of the exposure peak. To address these characteristics, the effects of beta-cyfluthrin on rainbow trout were evaluated with two independent early life stage tests (ELS): a standard Tier 1 study with constant exposure and a Tier 2c study under time variable exposure. Observed effects differed in these two studies. Under constant exposure, severe mortality and significant growth effects were observed while under peak exposure, no effects on survival were observed, and only negligible effects on growth were found. The model was successfully calibrated using the constant exposure experiment, and then accurately predicted the effects observed in the peak-exposure assay. The model allows to differentiate from the fish does not pass the threshold for an effect on survival. This helps to explain why no mortality is observed in the peak exposure experiment. The no effect threshold for sublethal effects is passed in the modelling under constant exposure, which is consistent with the observations. In the peak experiment, the duration of the effect on the feeding behaviour is insufficient to induce large effects on growth in weight or lengths, because beta-cyfluthrin ingested from the ELS1 was removed from the system and the fry have difficulty to cope with reduced feeding over a short period. The modelling supports the experimental finding that under realistic exposure conditions, short term effects on the feeding behaviour do not lead to growth or survival effects, and gives a mechanistic explanation for this observation. We were able to derive a mechanistic explanation for the results from laboratory experiments conducted with three different early life-stages of the trout, and for different exposure profiles to beta-cyfluthrin. The model shows that results from both laboratory studies are consistent. This validated model has the potential to be used to make accurate in silico predictions of effects on fish early life stages from time-variable exposure profiles.

154 Prediction of effects on chemicals on three-spined stickleback populations in mesocosms V. David, INERIS; B. Goussen, University of York / Environment; J. Porcher, INERIS / INERIS UMRI SEBIO ECOT; R. Beaudouin, INERIS / Models for Ecotoxicology and the internal METEO

To improve environmental risk assessment, mechanistic models predicting the impacts of toxicants on populations such as individual-based models (IBMs) was suggested as relevant tools. Furthermore, IBMs can be coupled with DEB (Dynamic Energy Budget) models which describe physiological processes of an organism. However, the development of DEB-IBMs requires a large number of data of the organism, which is difficult to obtain from the environment. In this study, the model was used for predictions of three-spined stickleback populations during mesocosm experiments in control conditions. Indeed, the different descriptive variables of the populations (population size, male and female juvenile frequencies, lengths and coefficient of variations) were well described and were used to compare with the endpoints of mesocosms exposed to BPA. In conclusion, simulated endpoints of stickleback populations can thus be used as a baseline to compare exposed populations to BPA in order to improve environmental risk assessment. In a second step, the DEB-IBM could be adapted in order to introduce the effects of toxicants such as BPA on the individuals and thus extrapolate the effects at the population level.

155 New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment

155 Atmospheric Microplastic’s: A novel method for the identification of microplastic’s in the inhalable size range. J.M. Levermore

In a size range of 0.1 μm to 2.5 μm, a new Raman Spectroscopy (Raman) protocol has been developed for chemical analysis of PM samples. Using thermal desorption (TD) of PM samples, a novel method for the identification of microplastic (μP) has been identified (Bayer 2018). This approach removes operator bias while allowing for the chemical identification of all microP >3μm in size in a sample. To validate RSI for the identification of microP, the RSI protocol was implemented in the study of cotton fibres from clothing, which have been identified by other techniques such as TGA, DSC and FTIR. The quantitative analysis of these plastic fibres is particularly difficult because of their low abundance and low detection limits. The study investigated the identification of microP in the environment using a new protocol.

156 Analysis of polystyrene based microplastics in the environment

G.F. Schirinz, iDEA-CSC; IDAEM; M. Farre, iDEA-CSC; Environmental Chemistry; m. ferré-urgell, iDEA-CSC; D. Barcelo, IJQAB-CSC / Department of Environmental Chemistry

Marine anthropogenic litter is a severe environmental problem. Wastes discarded or deposited in aquatic environments (including rivers, estuaries and coastal waters) usually consist of metal, glass, wood and plastic, being the 80% of these plastic wastes. One of the main issues is the extreme stability of plastic wastes. Under environmental conditions, the erosion of these materials generates smaller fragments some of them in the nano- and microscopic scale, which are known as nanoplastics (NPLs) and microplastics (MPLs), respectively. The quantitative analysis of these plastic fibres is particularly difficult because of their physicochemical properties (low solubility, a wide range of molecular weights, etc.) and potential contaminations sources in the laboratory. For these reasons, different approaches should be considered to find a standardised protocol for the determination of MPLs and NPLs in the environment. In this context, this study was focused on the investigation and practical comparison and combination of different analytical tools for the qualitative and quantitative analysis of MPLs/NPLs using: (1) techniques to assess the physicochemical properties such as Thermogravimetric Analysis or TGA, Differential Scanning Calorimetry or DSC, and Fourier-Transformed Infrared Spectroscopy or FT-IR; (2) qualitative and quantitative information by techniques based on direct mass spectrometric as high resolution mass spectrometry with Electrospray ionization (E_SI), Atmospheric Pressure Chemical Ionization (APCI), Atmospheric Pressure Photoionization (APPI), Matrix-assisted Laser Desorption Ionization (MALDI), Desorption Electrospray Ionization (DESI) and Direct Analysis Real-Time (DART). These studies have been carried out using as a representative polymer the polystyrene (PS), which is one of the most frequently used for plastics production. Finally, LC-API-HRMS complemented by other techniques such as TGA, DSC and FT-IR allowed obtaining qualitative and quantitative information about the whole spectrum of polymers, which may be present in the environment.

157 Uptake, excretion and accumulation of microplastic in mussel after an experimental exposure

B. Fernández, Instituto Español de Oceanografía / Marine Pollution and Biological Effects Department; M. Albertos, Instituto Español de Oceanografía / Marine Environment and Environmental Protection Area. Fisiology and Ecotoxicology of Bivalve Molluscs Department

Filter feeding invertebrates such as mussels are especially susceptible target species to microplastic (MP) ingestion. Field and laboratory studies have reported that MP are ingested by mussels. Once ingested, MP may be ejected through defecation,
obtained in the digestive system, and/or transferred through the haemolymph to other body tissues (translocation). However, the knowledge on the ingestion and egestion of MP and on the accumulation of MP within different organs of mussel is limited. In this context, a laboratory experiment was conducted to investigate the kinetic of uptake and egestion of MP and its accumulation in digestive gland of mussel. To this end, individual mussels, Mytilus galloprovincialis, were exposed in a temperature close to two nominal concentrations (2 and 4 mmol L⁻¹). Low and High MP dose, respectively, of microalgae (MA) (Isochrysis galbana, clone t-ISO) and MP (high-density polyethylene, HDPE) of similar size (Results showed no differences between the uptake kinetic of MP and MA, indicating a similar capture efficiency and acceptability for both types of particles by mussel. After 120 hours of the exposure, mussels had ingested around 40% of the MP exposed. The highest volume of MP (3 mmol L⁻¹) was collected after 24 hours of the exposure. Then, lower volume of MP was collected in faeces and collected after 48 hours (around 20%) and 120 hours (8%) of the exposure. The diameter of the MP particles egested decreased with time. The highest particle diameter (about 9 µm) was observed in the MP egested after 4 hours of the exposure. This may be related to a size-dependent rejection of larger MP particles in faeces. Results showed that after 120 hours of the exposure the 6% and 2% of the MP ingested was accumulated in the digestive gland of mussels exposed to the Low and High MP dose, respectively. The diameter of this MP (around 3 µm) was significantly lower than that of the MP offered (8 µm) and the MP egested (6-9 µm). This suggested a specific removal through faeces of larger MP particles and the retention of smaller ones in the digestive system.

158 Analysis of tire wear particles in environmental samples using TED-GC-MS P. Eisenbraut, Bundesanstalt für Materialforschung und -prüfung; E. Dümichen, Bundesanstalt für Materialforschung und -prüfung / 5.3 Mechanics of Polymers; A.S. Ruhl, TU Berlin / Department of Water Quality Control; M. Jekel, TU Berlin; M. Abbas, UFZ / Department of Water Quality Control; U. Braun, BAM / Federal Institute Materials Research and Testing / 5.3 Mechanics of Polymers Tire and road wear particles (TRWP) as environmental contaminants have received increasing interest since the 1960s[1]. TRWP have adverse effects on human health[2]. Multiple cities in the EU are discussing the impulses we give and share their opinions throughout the presentation. This will cover opinions on the need of a framework for environmental plastic debris. In addition, the platform will host a discussion on the direction of future research and legislation. To help decide whether a consensus definition and categorization framework for plastic debris is valuable and if so how this might look, the scientific community needs to engage in a critical discussion. The aim of our presentation is to foster such discourse in the SETAC community by providing impulses and sharing our thoughts rather than providing definitive answers. In our presentation, we will use a new format with two presenters jointly discussing the advantages and disadvantages of a definition. Further we will discuss our ideas on relevant components of a definition/categorization framework. To get immediate feedback by the community, we will use online polling asking specific questions to the audience throughout the presentation. This will cover opinions on the need of a definition, acceptance of certain defining and categorizing criteria and questions on special cases with high uncertainty. The aim of this is to get an ad hoc idea on where consensus may be easy to achieve and areas which are controversial. Finally, we will present an online platform (www.microplastics.eu, currently under development) that we will use to perform a large-scale survey on a consensus definition of environmental plastic debris. In addition, the platform will host a module for discussing the questions mentioned above and a module for networking. This platform can be used by the audience and the wider community to further discuss the impulses we give and share their opinions and input.

Advances in environmental risk assessment of oil spills and offshore oil & gas operations (II)

160 Are we speaking the same language? Towards a definition and categorization framework for environmental plastic debris M. Wagner, Norwegian University of Science and Technology / Department of Biology; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; A. Verschueren, BAM / Centre for Safety of Substances and Products; T. Hüffer, University of Vienna / Department of Environmental Geosciences; M. Hasselöv, University of Gothenburg / Department of Marine Sciences; R.C. Thompson, Plymouth University / School of Marine Science and Engineering. The occurrence and accumulation of plastic debris is a global environmental issue, with potential consequences affecting the economy, wildlife and human health. However, there is currently a lack of consensus on the definition and categorisation of environmental plastic debris, including macro-, micro- and nanoplastics. The lack of clarity in terminology regarding plastic debris, in particular microplastics, results in confusion and misunderstandings. This is problematic both for legislative measures as well as for general coherence and data comparability between studies. While lacking a common language can be beneficial and areas which are controversial. Finally, we will present an online platform (www.microplastics.eu, currently under development) that we will use to perform a large-scale survey on a consensus definition of environmental plastic debris. In addition, the platform will host a module for discussing the questions mentioned above and a module for networking. This platform can be used by the audience and the wider community to further discuss the impulses we give and share their opinions and input.
pelagic and reef fishes, including mahi-mahi (Coryphaena hippurus) and bicolour damselfish (Stegastes partitus). To date, within the marine teleost group, nothing is known about how crude oil exposure affects the detection of olfactory cues or if crude oil can be detected and avoided. To address these questions, the time that control and oil-exposed bicolour damselfish spent in a chemical alarm cue and the time that control and oil-exposed mahi-mahi spent in diluted crude oil was examined using a two-channel flume test system. Fish exposed to diluted crude oil avoided a cosmetic chemical alarm cue, whereas exposed conspecifics did not avoid the cue (p < 0.001). Control mahi-mahi did not distinguish between seawater and crude oil, however oil exposed mahi-mahi spent a greater proportion of time in crude oil than the control fish (p < 0.01). Moving forward, an electro-olfactogram technique will be used to measure the generator potential from the olfactory epithelium of bicolour damselfish and mahi-mahi to detect the response to olfactory cues following oil exposure. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

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A wide range of endpoints are impacted by oil exposure in early and later life stages of marine fish

M. Grosell, J.D. Stieglitz, RSMAS University of Miami / Marine Biology and Ecology; R.M. Heuer, University of Miami / Marine Biology and Ecology; C. Pasparakis, Rosenstiel School of Marine Sciences / Marine Biology and Fisheries; L. Schwebker, RST, OA exposed fish. Such reductions in cardiomyocyte contractility are likely related to impaired cellular calcium cycling also suggested by RNAseq data. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

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Investigating the endocrine disruptive and genotoxic potential of crude oil samples using adapted in vitro toxicity tests

S. Johann, Institute for Environmental Research RWTH Aachen University; L. Nuesser, RWTH Aachen University, Institute for Environmental Research / Department of Ecosystem Analysis; L. Spencer, Institute for Environmental Research RWTH Aachen University / Department of Ecosystem Analysis; D. Altin, BioTrix; H. Hollett, RWTH Aachen University / Institute for Environmental Research; T. Seiler, RWTH Aachen University / Ecosystem Analysis In case of an acute oil spill the decision on optimal response techniques to achieve the best environmental benefit is based on important knowledge about regional ecosystem function. Even adult marine fish are sensitive to brief, low level oil exposures, showing reduced aerobics score and swim performance. The lower swim performance in adult oil-exposed fish with a normally developed heart, is due to reduced cardiac output driven by reduced stroke volume. Work on isolated cardiomyocytes show that sarcomere shortening upon electrical stimulation is reduced by acute oil exposure which likely explains the reduced stroke volume observed in fish. Such reductions in cardiomyocyte contractility are likely related to impaired cellular calcium cycling also suggested by RNAseq data. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

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Impacts of Oil Exposure on Mahi Embryos

C. Pasparakis, Rosenstiel School of Marine Sciences / Marine Biology and Fisheries; L.E. Sweet, Environmental Protection Agency USA; E.M. Mager, University of North Texas / Department of Biological Sciences; J.D. Stieglitz, RSMAS University of Miami / Marine Biology and Ecology; D.D. Benetti, RSMAS University of Miami / Department of Marine Ecosystems and Society; A.P. Roberts, University of North Texas / Department of Biology Institute of Applied Science; D.D. Benetti, RSMAS University of Miami / Marine Biology and Ecology; D.A. Crossley, University of North Texas / Department of Biological Sciences; J.D. Stieglitz, RSMAS University of Miami / Marine Biology and Ecology; H.A. Shiels, G.L. Galli, University of Manchester / Faculty of Biology, Medicine and Health Sciences; G.K. Cox, J.D. Stieglitz, RSMAS University of Miami / Marine Biology and Ecology; D.D. Benetti, RSMAS University of Miami / Department of Marine Ecosystems and Society; M. Grosell, RSMAS University of Miami / Marine Biology and Ecology; D.A. Crossley, University of North Texas / Department of Biological Sciences

The Deepwater Horizon spill coincided with the spawning window of many ecologically and economically important fish species, such as mahi-mahi (Coryphaena hippurus). Aside from the acute mortality elicited by this event, additional sublethal effects may have imparted more subtle yet ecologically significant consequences on populations of pelagic fishes as a whole. The recovery of embryo/baby fish is critical to survival, and aids in promoting natural dispersal by facilitating drift through ocean currents and positioning newly hatched larvae in the upper water column where planktonic food is plentiful. We found that co-exposure to oil and additional environmentally relevant stressors, such as high light and UV-radiation, affect the timing and duration of negative buoyancy in mahi-mahi embryos. Furthermore, reduced negative buoyancy was coupled with significantly faster sinking rates and increased energy depletion, likely resulting in detrimental consequences for these developing fish. The mechanisms behind untimely buoyancy change are unknown, but our findings suggest a behavioral avoidance response as well as an inability to maintain buoyancy due to diminished energy reserves. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

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Crude oil impairs heart cell function in the pelagic mahi-mahi (Coryphaena hippurus)

R.M. Heuer, University of Miami / Marine Biology and Ecology; H.A. Shiels, G.L. Galli, University of Manchester / Faculty of Biology, Medicine and Health Sciences; G.K. Cox, J.D. Stieglitz, RSMAS University of Miami / Marine Biology and Ecology; D.D. Benetti, RSMAS University of Miami / Department of Marine Ecosystems and Society; M. Grosell, RSMAS University of Miami / Marine Biology and Ecology; D.A. Crossley, University of North Texas / Department of Biological Sciences

Crude oil from the Deepwater Horizon spill of 2010 has been shown to have a number of cardioactive effects across life stages, species, and levels of organization in marine fish. Over the last decade, the use of the mahi-mahi (Coryphaena hippurus) to study these cardiovascular impairments has been particularly important, since this pelagic species is both ecologically and economically important, such as mahi-mahi (Coryphaena hippurus). Aside from the acute mortality elicited by this event, additional sublethal effects may have imparted more subtle yet ecologically significant consequences on populations of pelagic fishes as a whole. The recovery of embryo/baby fish is critical to survival, and aids in promoting natural dispersal by facilitating drift through ocean currents and positioning newly hatched larvae in the upper water column where planktonic food is plentiful. We found that co-exposure to oil and additional environmentally relevant stressors, such as high light and UV-radiation, affect the timing and duration of negative buoyancy in mahi-mahi embryos. Furthermore, reduced negative buoyancy was coupled with significantly faster sinking rates and increased energy depletion, likely resulting in detrimental consequences for these developing fish. The mechanisms behind untimely buoyancy change are unknown, but our findings suggest a behavioral avoidance response as well as an inability to maintain buoyancy due to diminished energy reserves. This research was made possible by a grant from The Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

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SETAC Europe 28th Annual Meeting Abstract Book
166 microRNA and messenger RNA networks in early life stages of pelagic and nearshore fish species exposed to Deepwater Horizon oil
dD. Schlenk, University of California-Riverside / Department of Environmental Sciences
G. Xu, UC Riverside / Department of Environmental Sciences
Developmental cardiotoxicity is a common phenotype observed in a number of fish species following exposure Polyaromatic hydrocarbon (PAH) or oil. While many PAHs elicit cardiotoxicity through activation of the aryl hydrocarbon receptor (AhR). Additional pathways of toxicity have been observed including downregulation of genes that regulate potassium and calcium channels in embryonic and larval stages of development. While functional inhibition the channels has been observed following exposure to oil and non-AhR activating PAHs, mechanisms associated with downregulation has not been observed. MicroRNAs (miRNA) play key roles in a number of diverse biological processes including heart development in vertebrates. To test the hypothesis whether miRNA changes may regulate ion channel genes, embryos and larvae of mahi-mahi (Coryphaena hippurus) were treated with High Energy Water Accommodated Fractions (HEWAF) made from source and weathered DHW oil. miRNAs and mRNA were sequenced from the same pooled animals and expression compared using advanced bioinformatics with subsequent target organ predictions based on their interactions. Gene ontology (GO) analysis on the target miRNAs was consistent with pathway analysis of miRNAs, predicting disruption of cardiovascular system development after oil exposure and showed that specific miRNA–mRNA interactions may contribute to these effects (Figure 1). Oil caused an overexpression of mir-133a, mir-34, and mir-19b (Figure 2). Enhanced expression of mir-133a correlated to the decrease in the expression of KCNH2 mRNA, which controls the potassium ion transporter that has been observed to be reduced in the cardiac phenotype in multiple fish species following oil treatment. In addition, miR-34 and miR-19b, were also upregulated and informative analyses with miRNAs were consistent impairment of eye development (Figure 2). Ongoing analyses of dose response treatments at early hatch larval stages (48 hpf) will provide additional data that will enhance our knowledge of the impacts of oil on fish development. This research was made possible by a grant from the Gulf of Mexico Research Initiative. Grant No: SA-1520; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

Alternative Approaches to Animal Testing for Ecotoxicity Assessments

167 Early life stages of a vertebrate species as an alternative model for the study of stressors in marine environment
M.J. Aragão, CESAM & DeBio / APPLLEE; R.J. Rocha, Department of Biology & CESAM - University of Aveiro / Department of Biology and CESAM; C. Quintaniero, Department of Biology & CESAM - University of Aveiro; A.M. Sousa, University of Aveiro / Department of Biology & CESAM; M. Monteiro, Aveiro University / Biology
Early life stages of marine vertebrates have been scarcely used in ecotoxicity testing. The Senegalese sole (Solea senegalensis Kaup, 1858) is a common vertebrate occurring in Eastern Atlantic coastal areas. Eggs of this marine vertebrate can be obtained from aquaculture rearing facilities and used in laboratory as testing organisms. At the end of the first month of life this species completes a metamorphosis, changing from bilateral to flatten shape morphology. Early life stages of aquatic vertebrates are windows of development considered highly sensitive to anthropogenic contamination, including in marine environment. Organic compounds, such as pesticides and personal care products have been increasingly used, and directly released to the aquatic ecosystems or indirectly released from wastewater treatment plants. Besides, human activities have been indirectly changing abiotic conditions, such as ultraviolet (UV) radiation. Therefore, in this work we aim to understand the effects of different stressors to early life stages of S. senegalensis, namely of UV radiation and of the organic compounds -MB, Carbendazim, Linuron and Triclosan, which have potential endocrine disrupting and larval stages of development. While behavioral development, growth, behavior and biochemical markers were evaluated as endpoints in two periods of exposure to stressors: a first initial period between egg stage and 96 hpf and a second period during the nearly 15-day full metamorphosis progression of S. senegalensis. Exposure to UV radiation and to the four organic compounds (compounds -MB, Carbendazim, Linuron and Triclosan) was performed. Our results suggest that the sensitivity of S. senegalensis larval stages to ecotoxicity testing requires the evaluation of effects at different development stages. Initial egg stages globally display a higher sensitivity to stressors, presenting lower LC50 and EC50 values. Besides, biochemical markers (cholinesterases and oxidative stress) were differently affected, depending on S. senegalensis life stage. Significant alterations of normal behavioural pattern were observed in response to stressors exposure, confirming behavior as a sensitive and relevant tool in ecotoxicity studies. The increasing environmental levels of the contaminants tested may lead to adverse effects on highly sensitive life stages of marine vertebrate species.

168 Predicting in vivo toxicity from in vitro transcriptional responses following chemical exposure
D. Basil, University of Liverpool / Institute of Integrative Biology; M. Knobel, Eawag / UTOX; A. Sawle, Cancer Research UK Cambridge Institute / Department for Systems Biology; J. Herbert, P. Arntzen, University of Liverpool / Institute of Integrative Biology; K. Schirmer, Eawag / Environmental Toxicology; A. Cossins, F. Falciani, University of Liverpool / Institute of Integrative Biology
Alternatives to in vivo animal testing in ecotoxicology aim to increase the throughput of chemical safety assessment whilst reducing the number of animals used. The use of in vitro systems is more cost-effective, practical and expedient. However, it is still unclear whether in vitro methods provide the level of information gained from the use of a whole-living system. In vitro to in vivo extrapolation relies on measuring the effects of chemicals on cultured cells or biological molecules to predict how exposure to those compounds might cause adverse effect in animals or people. In this study, we investigated whether the transcriptional state of a trout gill cell line (Oncorhynchus mykiss, RTgill-w1) exposed to a given chemical can be used as a biosensor to predict toxicity in a zebrafish embryo (Danio rerio). More specifically, we developed a regression model linking gene signatures that are independent of compound lipophilicity and predictive of toxicity. We show the ability of residual analysis to identify excessive toxicity and to accurately predict in vivo toxicity for most of the chemical MoA in the panel. Our results support the view that gill cell line has the potential to replace zebrafish embryo in toxicity testing.

169 Combining computational modelling with in-vitro cellular responses in order to predict chemical impact on fish growth
K. Schirmer, Eawag / Environmental Toxicology; H. Mottaz, R. Schoenenberger, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; J. Stadnicka-Michalak, EPFL Swiss Federal Institute of Technology / Environmental Toxicology
A paradigm shift in chemical risk assessment is needed due to the time-consumption and ethical controversies of current chemical testing on animals. However, in spite of several assumptions and simplifications, combining in vitro experiments with computational modelling can result in a powerful strategy for screening chemicals to determine their effects on fish growth. Moreover, the approach that no prior knowledge about chemical concentrations tested in vivo was required: in vivo data were needed only to validate the model but not to decide which chemical concentrations should be tested in vitro. More than ten organic chemicals (including fungicides, herbicides, insecticides, industrial compounds and pharmaceuticals) were tested for different fish species (rainbow trout, fathead minnow and zebrafish). The results indicate a very good agreement between measurements and predictions determined for different species of fish, being exposed in vivo from 7 to 62 days, depending on the species and test design. Results moreover confirm that it is possible to predict chemical impact on fish growth without prior knowledge on concentrations that are used in in vivo studies for chemicals that do cause an effect on fish weight as well as for those that do not. Therefore, in spite of several assumptions and simplifications, combining in vitro experiments with computational modelling can result in a powerful strategy for screening chemicals to determine their effects on fish. In addition, considering the simplicity, rapidity and low costs of this approach, we believe that it can be an encouraging step toward alternatives to long-term whole organism toxicity testing.

170 Ecological Threshold for Toxicological Concern (ecoto-TTC) - Applications for Environmental Risk Assessment in Various Contexts
M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI); M.G. Barron, U.S. EPA / Gulf Ecology Division; A. Beasley, The Dow Chemical Company / TERC; S.E. Behringer, The Procter & Gamble Company / Eawag / UTOX; J. Herbert, P. Antczak, University of Liverpool / Institute of Integrative Biology; H. Mottaz, R. Schoenenberger, Eawag / Environmental Toxicology; A. Cossins, F. Falciani, University of Liverpool / Institute of Integrative Biology
Alternatives to in vivo animal testing in ecotoxicology aim to increase the throughput of chemical safety assessment whilst reducing the number of animals used. The use of in vitro systems is more cost-effective, practical and expedient. However, it is still unclear whether in vitro methods provide the level of information gained from the use of a whole-living system. In vitro to in vivo extrapolation relies on measuring the effects of chemicals on cultured cells or biological molecules to predict how exposure to those compounds might cause adverse effect in animals or people. In this study, we investigated whether the transcriptional state of a trout gill cell line (Oncorhynchus mykiss, RTgill-w1) exposed to a given chemical can be used as a biosensor to predict toxicity in a zebrafish embryo (Danio rerio). More specifically, we developed a regression model linking gene signatures that are independent of compound lipophilicity and predictive of toxicity. We show the ability of residual analysis to identify excessive toxicity and to accurately predict in vivo toxicity for most of the chemical MoA in the panel. Our results support the view that gill cell line has the potential to replace zebrafish embryo in toxicity testing.

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wealth of ecotoxicological information as Predicted No-Observed Effect Concentrations (PNECs) on diverse chemical substances in the form of probability distributions. These enable the prediction of untested chemicals based on a structural attribute, mode of action, or functional use. The approach may be useful for assessing chemicals at early tiers of the risk assessment process, providing hazard perspective on chemicals that lack QSARs, guiding product development discussions, and assisting read across or category justifications. An ecotoxicological database of approximately 120,000 records was developed based on recent assessments of published data and international chemical management programs. This ecotoxicity data is associated with physical chemistry data and curated taxonomic information for the organisms tested, including a process to conclude acute and chronic effects as well as identify potential for exposure, assessment of endpoints based on end breadth of data. Several modes of action schemes are also included to facilitate development of a best approach for grouping compounds. To make these data accessible and useful to stakeholders, the database was transitioned from Microsoft Excel and Access into a modern MySQL database, allowing for a format that is relational and scalable, facilitating easy access, sharing, and integration with other datasets and tools. The dataset is accessed via a web-based query system that is integrated with PNEC calculator and probability distribution tools. The novel interface allows users to explore the data, upload additional datasets, derive threshold values based on specific criteria, and explore the potential use and application of the ecotoxicity concept. An international workshop was held to discuss and evaluate the feasibility of the eco-TTC approach, which included evaluation of several case-studies based on particular decision-contexts (e.g., prioritization and screening, chemical risk MOAs). In the subsequent risk assessment, mixtures, product development, criteria development). This presentation will highlight the discussions and conclusions from a recent multi-stakeholder workshop, including exploration of how this approach could be applied and integrated into evaluation strategies.

171 Mode of action diagnosis by normalized multiple endpoint assessment in zebrafish embryos
E. Teixido, Helmholtz Center for Environmental Research - UFZ GmbH / Department of Bioanalytical Ecotoxicology; N. Klaver, Helmholtz centre for environmental research - UFZ / Department of Cell Toxicology; D. Kerkhof, Helmholtz centre for environmental research - UFZ / Department Bioanalytical Ecotoxicology; M. Leonard, IOREAL SA; T. Kieling, Scientific Software Solutions; R. Altenburger, UFD Centre for Environmental Research / Department Bioanalytical Ecotoxicology; S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology

The diagnosis of a specific or reactive mode of action (MoA) is crucial for the prediction of adverse effects using alternative test systems. While baseline toxicity can be easily predicted using regression-based QSRs, the identification of non-baseline toxicants requires assessment of endpoints that can be related to the MoA of a chemical and ultimately assign an adverse outcome pathway. Such a MoA analysis could be possible using the zebrafish embryo test (ZFET) extended by various endpoints such as chemical risk MOAs. In the specific risk assessment, mixtures, product development, criteria development). This presentation will highlight the discussions and conclusions from a recent multi-stakeholder workshop, including exploration of how this approach could be applied and integrated into evaluation strategies.

172 Poster spotlight: MO158, MO159, MO190
Migratory bird species at risk - the role of pesticides and other chemicals

173 CMS talk setting the scene for the CMS working group on poisoning and outlining CMS needs in terms of scientific input from SETAC
B. Heredia, UNEP/CMS / Avian Unit

174 Main scientific gaps in knowledge of risk from pesticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions - POSTER SPOTLIGHT MO456
C.A. Bishop, Environment and Climate Change Canada / Wildlife Research Division

175 Main scientific gaps in knowledge of risk from rodenticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions - POSTER SPOTLIGHT MO457
P. Berny, VETAGRO-SUP / Toxicology

176 Main scientific gaps in knowledge of risk from Pb ammunition and shot to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions - POSTER SPOTLIGHT MO458
R. Crennie, Wildfowl & Wetlands Trust

177 Main scientific gaps on knowledge of NSAIDs [migratory] wildlife globally, and potential contribution of WTIG to CMS questions - POSTER SPOTLIGHT MO459
M. Taggart, University of the Highlands and Islands / Environmental Research Institute

178 Main scientific gaps on knowledge of deliberate poisoning to [migratory] wildlife globally - POSTER SPOTLIGHT MO460
M. Odino, Independent Environmental Services Professional

179 Questions and discussion

180 Regulatory view describing the extent to which [if any] regulation takes into account neighbouring country/regional use of compounds, accounts for how local use might affect migratory species, how field data on migratory species might feed into regulatory
R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit

181 Panel discussion with audience and presenters focusing on how SETAC can interact with CMS usefully to provide scientific evidence and expertise

**Challenges in setting, meeting and measuring specific protection goals for plant protection products**

182 Towards a more holistic environmental risk assessment approach of crop protection products as tools in agriculture
P. Dobmen, BASF SE / Environmental and Consumer Safety, Ecotoxicology
Currently, very complex risk assessment approaches are conducted for crop protection products. This is largely justified as pesticides are intentionally introduced into ecosystems and since these substances are intended to have effects on “crop pests” and side effects on non-target species cannot be fully avoided. However, doing so, we often ignore the context, the reasons why crop protection products are utilized. This ignorance can lead to failing the overall targets or lead to sub-optimal or even wrong decisions. This will be explained in more detail in the following presentation advocating for a more holistic approach in environmental risk assessment. Agriculture per se does have an impact on the environment and...
does reduce biodiversity at the sites used for food production. This, in principle, is true for any kind of agriculture. As a consequence, it is irrational to demand that agriculture, respectively the different agricultural practices, shall have ‘no impact’ on the environment. Accordingly, regulations require that ‘no unacceptable impact’ may occur. To define what constitutes an acceptable impact and what not, the ‘Ecosystem Services’ concept is considered a suitable approach. This is not a call for ignoring the impact of crop protection products. However, for achieving our targets and maintaining a sufficient local food production with an optimal environmental impact we need to have a broader approach and evaluate the cost/benefits of all agricultural tools equally against the background of food produced per area. Scientific tools to go for such more complex holistic approaches are partly available, but more efforts are needed to develop practical and manageable concepts allowing an optimal crop protection. In addition, the regulatory options have to be broadened from mere risk assessment of chemicals towards a landscape level assessment of food production, and risk management has to include landscape management options. Ecotoxicological research is undoubtedly important; however, in order to achieve the overall target of feeding human populations in a sustainable way and maintaining ecosystem health, we need to cover all aspects of ‘stress ecology’ (impacts of humans on ecosystems) beyond the impact of chemicals. Therefore this call for a more holistic environmental risk assessment approach.

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Identifying ecosystem services-based protection goals.

J. Malby, Y. Pan, The University of Sheffield / Dpt of Animal Plant Sciences

There is an increasing interest in the use of ecosystem service-based approaches for assessing the risk of environmental contaminants to ecological systems. Ecosystem functions become ecosystem services when they are utilized and valued by people. Therefore, the first step in implementing an ecosystem services approach to ecological risk assessment is to identify what portfolio of services are required, by whom and where they should be protected. But how do we evaluate preferences and contribute to identifying the services to be protected and how should preferences be assessed? These questions are particularly pertinent when considering the role of the general public in protection goal prioritization. Here we use information from case studies in the UK and China to investigate the importance of: who you ask (do different sections of society have different preferences?), what they know (how does prior knowledge influence preferences?), how preferences are assessed (e.g. stated v revealed preferences). We demonstrate that all three factors can have an impact on which freshwater ecosystem services are preferred by the general public and therefore should be prioritized for protection.

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ECPA over-arching Specific Protection Goals proposal for EFSA Non-Target Terrestrial Plants, Non-Target Arthropods and Soil Organisms Guidance Documents based on EFSA Ecosystem Services approach

K. Romijn, Bayer CropScience AG

Currently there are 3 Scientific Opinions from EFSA that are waiting to be developed into Guidance Documents i.e. Effects of pesticides on Non Target Terrestrial Plants, Non Target Arthropods and Soil Organisms. Whilst each of these Scientific Opinions makes proposals for SPGs, the European Commission and Member States should agree on the on SPGs before they can be taken forward to be used in the Guidance Document development phase. The purpose of this paper is to provide industry input for consideration and discussion during this process. In an earlier EFSA Scientific Opinion it was recommended by EFSA that Specific Protection Goals (SPGs) should be based on the principle of Ecosystem Services utilising 6 dimensions: i.e. biological entity, attribute, magnitude, temporal and geographical scale of the effect, and the degree of certainty that the specified level of effect will not be exceeded. Whilst this EFSA Scientific Opinion is a good basis for setting SPGs going forward, the experience with the EFSA Bee Guidance Document shows there is a need to reconsider how the principles described in this EFSA SPG Opinion are applied to SPG setting in individual Guidance Documents. In the case of the EFSA Bee Guidance SPG it was not the definition of “negligible effects” on colony strength that was the controversial issue but the translation of this into a numerical value (< 7%) without robust scientific justification. The use of 7% was suggested there was data to support it but in fact it was still a judgement, i.e. it is a hidden ‘judgement’. The suggestion that effects in entomological units of the bee populations between large (>35%), medium (15-35%) small (7-15%) and negligible (3.5-7.5%) is in itself surprising for a biological system particularly one with complex feedback loops such as in honeybee colonies. To avoid the difficulty of selecting a specific hard numerical SPG value upon which consensus between different scientist and stakeholders is vital, it is recommended to write an explicit judgemental qualitative approach adapting the EFSA Ecosystem Services approach. The predicted impact of any effect of a PPP on an invertebrate/plant population should be described using expert judgement, which combines the predictions of all 4 EFSA dimensions above (attribute/nature of effect, magnitude, temporal and spatial scales of effects) as well as the number and importance (eg. keystone species) of species potentially affected, and the frequency of occurrence.

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Protection goals for non-target terrestrial plants: Is in-field protection of beneficial weeds achievable?

J. Davies, Syngenta / Environmental Safety; L. May, A. Russell, A. Seville, D. Stock, Syngenta

EFSA’s Scientific Opinion addressing the definition of non-target plants as all plants growing outside fields and those growing within fields that are not the intended pesticide target. It also states that non-crop plants growing in field areas provide ecosystem services including food web support, aesthetic value, genetic resources and endangered species, which require protection from the adverse effects of plant protection products. As such, The Opinion advocates the protection of plant species growing in-field that under current agricultural practice would be considered target weeds. This approach differs from other EFSA ecosystem services provided by non-crop plants growing in-field, have been discussed in various stakeholder workshops and publications. Proposed options for protecting in-field ecosystem services include (a) compensation mechanisms whereby designated areas are set aside specifically for NTPPPs, and (b) beneficial weed protection, which involves the control of those weed species that compromise crop yield while not affecting other species that are considered to have ecosystem service value. This second option relies upon the availability of highly selective herbicides and/or other methods of selective weed control. In order to inform this debate, the feasibility of beneficial weed protection will be considered from three perspectives: (a) issues relating to the definition of beneficial weed species (b) potential agronomic consequences of protecting beneficial weeds and (c) challenges facing the landscape that conserves species and promotes wellbeing. To this aim, EFSA Guidance requires that a surrogate system for the Final Reference (term the Surrogate Reference Tier) scientifically underpins the assumption that the endpoints assessed at High Tier are closer to the actual objectives of the adopted protection goal. It is accepted that Low Tier assessments do not measure the SPG directly, and therefore at High Tier, endpoint assessment should rely on ecological and ecotoxicological data that are directly related to the ‘target image’ of the aquatic community. This surrogate system should be relevant for the surface water at risk, and endpoints should account for the ecological traits of the important aquatic species at risk. The EFSA PPR Panel’s solution was to identify for each Key Driver (taxonomic group or other ecological entity), a Surrogate Reference Tier that is based on the most sophisticated experimental or modelling approach available to address the SPG. Consequently, scientists should ensure that Aquatic High Tier experimental approaches are (a) the most sophisticated approach available and (b) represent the ‘target image’ of the biocentric aquatic communities that support the relevant ecosystem services. Perhaps in this context, the most important assessment endpoints are those that reflect natural and real-based effects, and those that preserve the biodiversity of the aquatic communities that ultimately present the ‘target image’ and therefore closer relevance to the Final Reference.

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Is “biodiversity” a measurable study endpoint?

F.M. Bakker, Eurofin-Intertek

The general protection goal addressed by current and future risk assessment schemes for Plant Protection Products is Biodiversity. In addition to this there are specific protection goals that may conflict with the general protection goal. Specific protection goals are generally phrased in terms of Ecosystem Services and expressed in human currency there is a risk that economic motives may prevail in their prioritization. After all, who is to judge e.g. whether preservation of pest control capacity outweighs the preservation of aesthetic value? Biodiversity is a concept with many facets and the quantification of biodiversity is no straightforward exercise. A vast array of indices exists (see e.g. Magurran 2004)
and not a single one would capture the essence on its own. The two basic parameters involved in biodiversity measures are the number of species and their abundance. Their correct estimation is core to biodiversity assessments and their balance describes community structure in terms of e.g. dominance, evenness and diversity. Similarity indices have been developed that enable the comparison of (sub)habitats, which seems a promising lead to assessing effects on biodiversity in experimental designs. With this contribution we explore different approaches to quantifying effects on structure and function caused by contaminant protection products in an experimental setting. We apply and compare multivariate statistical approaches, similarity indices and a combination of univariate statistics and species richness assessments and discuss how these findings may address the general issue of effects on biodiversity.

Innovative techniques for enhancing and monitoring microbial activities for in situ remediation of contaminated sites

188 Evaluation of plant-driven biostimulation of soil microbe for the setup of a site-specific rhizoremediation process in a historical PCB-polluted soil L. Vergani, University of Milan / DeFENS; F. Mapelli, University of Milan-DeFENS / Department of Food, Environmental and Nutritional Sciences; E. Terzagli, University of Insubria (Como) / Department of Science and High Technology, Como; G. Raspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; O. Uhlik, University of Chemistry and Technology, Prague; E. Zandonella, C. Morosini, University of Insubria / DSAT; A. Di Guardo, University of Insubria / Department of Science and High Technology; S. Borin, University of Milan / DeFENS

The Site of National Priority (SN) Brescia-Caffaro is a highly polluted area in Northern Italy presenting mixed and uneven soil contamination by metals and organic pollutants, in particular polychlorinated biphenyls (PCBs). In order to evaluate the bioavailability and rhizocommunity of soil plant species, and to determine the potential of plants for the development of a suitable rhizoremediation strategy, an experimental trial including ten vegetated treatments and their non-plant controlled plots was set up for 18 months in greenhouse conditions. Molecular fingerprinting was applied to unveil the ability of different plants/soil treatments to shape the structure of soil microbial communities. The results showed a succession over time in both bacterial and fungal assemblies. Only the diversity of the bacterial community was, nevertheless, significantly and differentially influenced according to the applied treatment. The stimulation effect on the organic matter hydrolytic activity of the soil microbiota was evaluated using fluorescein diacetate as a proxy. All the vegetated treatments showed a significant increase in activity after 18 months from planting, demonstrating effective biostimulation of the soil bacterial communities, putatively enhancing their degradation capacity and, consequently, sustaining rhizoremediation. Aiming to select bacterial strains to be exploited for autochthonous bioaugmentation coupled to rhizoremediation, we established a collection of isolates from the soil biostimulated by Phylatis arundinacea. This species cultivated in conditions of redox cycle showed to stimulate the highest increase in soil bacterial activity after 3 months from planting. Microbial consortia, with the 18-month biostimulated soil was incubated with 1C1-labelled 4-chlorobiphenyl, the production of 1C1CO2 indicated metabolic activity of biphenyl and possibly the presence of PCB-degrading populations. All the isolates were identified as Actinobacteria and were characterized for PCB-degradation and plant growth promotion. In particular, three Rhodococcus sp. strains significantly promoted lateral root development in the model plant Arabidopsis thaliana and depleted PCBs from the cultivation medium according to the results of a resting-cell assay, thus representing ideal candidates to sustain PCB-rhizoremediation through a site-tailored bioaugmentation approach.

189 Enhancement of Biological Reductive Dechlorination by in situ Adsorption onto Colloidal Activated Carbon: from the Lab to the Full Scale Application M.P. Papini, F. Arjmand, Università La Sapienza / Chemistry; P. Ciampi, C. Morosini, University of Insubria / DSAT; A. Giardi, University of Insubria / Department of Science and High Technology; S. Borin, University of Milan / DeFENS

The University of Rome “La Sapienza” has been commissioned to evaluate strategies for the management of the contaminated areas of the new High Speed Railway Station of Bologna (Italy), where a historical Chlorinated Aliphatic Hydrocarbons (CAHs) contamination has been found in two aquifers. CAHs contamination is generally constrained by low groundwater flow and can be transported over large distances. The site is characterized by a long-term contamination and reduced onshore discharge and, consequently, it was treated by a conventional anaerobic biodegradation process. In recent years, microbial electrochemical technologies (MET) have attracted considerable attention as an effective and sustainable remediation technique. The performance of the biocathodic electrochemical reactor was characterized in terms of degradation rate and yield. GC-MS analysis was also carried out in order to shed light on the “electrogenic” pathway of contaminants biodegradation. The measured species were mainly supported by the project BEvERAGE - BioElecTroomed Remediation of Groundwater plumes (2015-01955). [1] Palma E., Daghio M., Francesetti A., Petrangeli Papini M., Aulenta F. The biologic electowell: a novel approach for in situ treatment of hydrocarbon-contaminated groundwater. Micro Biotechnol., 2017: doi: 10.1111/1751-7915.12760.

190 An innovative bioelectrochemical reactor for in-situ treatment of groundwater contaminated by monoaromatic petroleum hydrocarbons E. PALMA, CNR-IRSA; M. Daghio, A. Franzetti, University of Milano - Bicocca / Department of Earth and Environmental Sciences; M.P. Papini, Università La Sapienza / Chemistry; E. Aulenta, National Research Council / Water Research Institute (IRSA)


191 Identification of major HMW-PAH degrading communities during active bioremediation of a PAH-contaminated soil J. Vila, Instituto de Recursos Naturales y Agrobiologia; M. Grifoll, Universitat de Barcelona / Dept. Genetica, Microbioologia i Estadistica; M. Aitken, North Carolina / Environmental Sciences and Engineering; J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiologia / Agroquimica y Conservacion del Suelo


Despite the 16S rDNA gene copy numbers (bacterial abundance) remained constant throughout the 5-month treatment period, the number of 16S rDNA gene transcripts (bacterial activity) dramatically increased (from 10^8 to 10^9 copies/g dry soil) during the initial 45 days, associated with major PAH removal. 16S rDNA gene sequencing revealed distinctive profiles for total and active communities that together with changes in pyrosequencing libraries, identified members of the site-specific remediation approach. The full-scale remediation plan was approved by the local authorities and completed by the end of 2016. This was the first example of a completed full-scale application of this approach in Europe and the monitoring results after more than one year are particularly encouraging. A very high reduction rate of contaminants was observed in all the treated zones. Together with classical chemical analyses, microbiological tools, such as qPCR and CARD-FISH, were used to verify the enhancement of the biological reductive activities induced by the simultaneous injection of activated carbon and electron donor.

Thus, the possibility to use a new dispersed colloidal activated carbon technology (Plumestop®; Regenesis) together with an electron donor to create an in-situ adsorption/biologically-reactive zone was deeply investigated and finally adopted as the site-specific remediation approach. The full-scale remediation plan was approved by the local authorities and completed by the end of 2016. This was the first example of a completed full-scale application of this approach in Europe and the monitoring results after more than one year appear particularly encouraging. A very high reduction rate of contaminants was observed in all the treated zones. Together with classical chemical analyses, microbiological tools, such as qPCR and CARD-FISH, were used to verify the enhancement of the biological reductive activities induced by the simultaneous injection of activated carbon and electron donor.
Gram-positive bacteria, associated to Mycobacterium, were mainly active during the last two months of incubation, when only residual fractions of HMW compounds were degraded. Community analysis during the period of major HMW-PAH removal identified members of the recently described order Imundisobacterales and members of Sphingiobium as the main active populations. Their role on HMW-PAH removal was confirmed by DNA-SIP. Members of the genus Sphingiobium showed major phyotypes related to the contaminant assimilation, while members of Imundisobacterales clearly predominated in incubations with 13C-pyrene and 13C-benz[a]anthracene. Interestingly, members of Mycobacterium, traditionally associated to HMW-PAH degradation were not detected in either of the incubations. Our results indicate the minor contribution of Mycobacterium to the degradation of the more labile fraction of HMW-PAHs. Their increased activity during the late incubation phase, where degradation kinetics were drastically attenuated, suggested their potential action on the residual fraction of contaminant.

New frontiers in Life Cycle Inventory data collection and modelling

The end of an era: is data and model exchange across LCA software tools finally possible?

M. Viere, PRe Sustainability; K. Cenian, PRe Consultants; A. de Schryver, European Commission; A. Genist, Ifu Hamburg; L. Zampori, European Commission / Joint Research Centre; C. Wolf, Tier3 Solutions GmbH; M. Dupriez, RDC Environment; S. Horlacher, thinkstep; E. Mieras, PRe Sustainability

In the context of the Environmental Footprint (EF) pilot phase, the European Commission requested the development of 70 representative products/organisations (RPs/ROs) so they are consistent with the requirements of the final product environmental footprint category (PEFCRs) and organization environmental footprint sector rules (OEFSRs), they use the prescribed EF-compliant secondary datasets, and can be made available for free to any user applying a PEFCR/OEFSR and are easily usable in the major existing LCA software tools. An implicit prerequisite is that software tools give equal results when calculating the impact of the same RPs/ROs. At the start, a document was established that defined the minimum requirements as well as the vetoes for modeling. This way, potential problems for implementability of the models in the different software tools were identified and their use was banned. Five software tools were included, GaBi, openLCA, RangelCA, SimaPro, and Umberto. The next step was to test the EF impact assessment (IA) results of all EF-compliant secondary datasets. This way, differences coming from their implementation or of the EF IA method could also be identified before testing the results of the models. Furthermore, the development of an extension to the International Reference Life Cycle Data System (ILCD) format (eILCD) enabled importing and exporting models between software tools. Finally, the models developed for RPs and ROs will be tested in the five software tools. The problems faced in importing, calculating and comparing the results of the developed models in the different software tools together with the suggestions to improve the data were collected. Some claim different results in different software tools used, often generally pointing to different “software”, without being more specific. The reason may be rather bound to methodology, age, version, flow list and import-export-interface aspects, or even a combination. This work is the basis to enable the reduction of software-system related issues and makes it easier to detect and prevent mistakes. Most importantly, now there is the commitment of the 5 tool developers to make available to all users in the course of 2018 a compliant import and export interface for the eILCD format. We believe this is a crucial step towards the exchange of data and models across software tools and the comparability of results.

LCA using real time information: the case of DEA-enabled monitoring of WWTP lifecycle environmental performances

A. Maruvagia, Luxembourg Institute of Science and Technology (LIST); E. Benetto, Environmental Research and Innovation (ERIN); D. Torregrosa, Luxembourg Institute of Science and Technology (LIST); E Benetto, Luxembourg Institute of Science and Technology (LIST); Environmental Research and Innovation

Life cycle assessment (LCA) is undergoing the effects of a data abundance era, which poses old (data storage) and new (data mining, computational speed) challenges. The deep integration of Internet of Things (IoT) in product- and service-oriented manufacturing systems has enabled a Big Data support for lifecycle modelling along the entire value chain, and the emergence of open-access IoT technologies now allow monitoring of the performance of crowd-sourced innovation. However, how to use this huge amount of data in a consistent way to obtain more precise, spatially and temporally differentiated life cycle inventories (LCIs) and life cycle impact assessment (LCIA) results is still not an easy task. In the case of wastewater treatment, the larger and larger availability of on-line measurements coming from sensors installed in many wastewater treatment plants (WWTPs) should theoretically enable daily benchmarking, ultimately allowing faster correction actions, when needed. However, WWTPs data still finds very limited use and is often simply stored. The aim of this work is to showcase an application of...
temporally differentiated LCA performed with real-time high frequency data and present a methodology for the on-line assessment of the shift in the performance of WWTPs. The implemented methodology performs a DEA-based benchmark coupled with LCA to evaluate the environmental impacts linked to the operation of a WWTP. A web application of the system is currently being developed using the Shiny R package. It will enable plant managers to calculate and visualize LCA results in real time by modifying customizable parameters.

196 Enhancing Land Use Change modelling with IO data

J. Schmidt, Aalborg University / Department of Planning; M. De Rosa, BONSAI / Agroecology

Land Use Changes (LUC) are responsible for around 11% of global GHG emissions, nearly the same as the transport sector. This is about half of the GHG emissions from coal-based electricity production worldwide. Nevertheless, LUC are often excluded from LCA studies because ascribing the LUC to their drivers distinguishing between production sectors is challenging and requires a complex global inventory data modelling. In order to address this, 2-0 LCA consultants has been developing a model for indirect LUC (iLUC) modelling in LCA since 2011 as part of a crowdfunded project. Recently, the model has been integrating into the multiregional hybrid Input-Output model EXIOBASE, thus providing an unprecedented level of detail in iLUC modelling. Differentiation between use of land among regions of the world is based upon information on potential land productivity in different locations. The IO data allow identifying the land supplied by each country to a specific user. This can be compared alongside standard and efficient laboratory assays.

197 WSmix: a globally regionalised Water Supply mix framework with current and prospective databases for use in LCA

S. de Brey, IFSTTAR / UMR-ITAP ELSA; P. Roux, Istea / ITAP ELSA-PACT; M. Núñez, TU Berlin / Sustainable Engineering; E. Loiseau, Istea; G. Junqua, École des Mines d'Alès / LGEI; A. Sferratore, Société du Canal de Provence; Y. Penru, SUEZ groupe / CIRSEE; R.K. Rosenbaum, National Research Institute of Science and Technology for Environment and Agriculture - Istea - UMR ITAP

Freshwater comes from different sources that are unevenly distributed in the world and different water users (e.g. domestic, agriculture, industry) need different water quality standards provided by local (surface, groundwater, rain), external (inter-basin transfers) and alternative sources (e.g. sea water). Water from these sources are withdrawn and processed via water technologies using the local electricity mix. The combination of water sources and technologies results in a regional water supply mix (WSmix) for each specific use. Current LCI databases do not include these mixes when modelling processes leading to a poor representation of water supply systems and related environmental impacts in LCA. Furthermore, changes in water sources, caused by changes of climate and socio-economic factors, will occur in the future. These changes should be considering in LCA of products or infrastructure with long lifespans. The WSmix framework aims to develop a WSmix framework for modelling current and prospective assessment (LCIA) model. Overall, the results show that for agricultural crops, iLUC increases the GHG emissions with 100-200%, for beef cattle 20-60%, for pigs 40-80%, for dairy products 40-60%, for wood products 50-300%, and for primary plastics 2-15%. The model is location agnostic and can be applied to any decision-making context concerning long-term effects of small-scale changes. The iLUC framework is now integrated in the global EXIOBASE model, thus accounting for all crops in all countries in the world. It has already been applied to more than 50 LCA studies and on several product categories.

198 The evolution of database- and tool development for Agri-Footprint

B. Durlinger, L. Kuling, Blombok Consultants

From performing individual Life Cycle Assessment (LCA) studies for specific products, the field is moving towards automated LCAs for full product portfolios and tool and database development. This ongoing evolution is a result of the increased quality and availability of background databases as well as an increased acceptance of LCA as the measurement and monitoring tool for environmental impact. However, a point has been reached where existing LCA software and data structures have become a limiting factor for further development. Therefore, we would like to present our recent developments regarding database and tool development for LCA purposes. Existing LCA software frameworks have become limiting in our database development, because they only have a limited set of calculation features and interfacing capabilities. Also, the data structure of existing LCA software has proven to be limiting. For example, there is no explicit distinction between a process, products/substances, and exchanges. This can result in loss of valuable information. Therefore, we have decided to develop our own database infrastructure and accompanying calculation and import/export modules, that provide enhanced flexibility. This allows for more freedom, we can now make our own choices on how data is stored, what types of analyses can be performed and how this information is presented to a user. In addition, we see a trend where LCA analysts are becoming more and more interested in advanced tools that utilise Life Cycle principles. For Agri-Footprint 2018 we are therefore developing a completely new framework in a Python/Django environment that aims leverage the past developments of Blombok Consultants and Agri-Footprint and utilise them to develop a cloud based Life Cycle Inventory datastore and calculation engine to support and improve both our internal data developments and to serve as a backbone for custom tools for users. With this presentation we hope to contribute to the advancement of LCA databases and tools by providing insight in recent Agri-footprint developments.

199 Poster spotlight: TU097, TU098

Behavioural Ecotoxicology: Unravelling behavioural responses to chemical contaminants in the environment

200 Do laboratory assays predict behaviour in the wild? A study with pharmaceutical pollutants

E. McCallum, Umea University; A. Sundelin, J. Fick, Umea University / Department of Chemistry; A. Alanaar, Swedish University of Agricultural Sciences SLU / Department of Wildlife, Fish & Environmental Studies; G. Hellström, Swedish University of Agricultural Sciences SLU; T. Brodin, Umea University / Department of Ecology and Environmental Science

Concern over the impact that pharmaceuticals have on wild aquatic organisms has increased over the past decade. Laboratory studies have shown that pharmaceuticals can cause sub-lethal changes to animal behaviour and physiology; however, few studies have addressed whether effects documented in the laboratory extend to the natural environment. We exposed fish to one of two pharmaceuticals (temazepam and irbesartan) commonly detected in the environment at two doses (80 ng/L, 1500 ng/L) and measured anxiety and activity responses (i.e. analysis of scototaxis to measure anxiety and activity responses) and in the field (downstream dispersal using PIT tags). We found no evidence that either pharmaceutical treatment affected behaviour in the laboratory (scototaxis) or in the field (dispersal using PIT tags).

201 Exposure to the widespread androgenic steroid 17β-trenbolone alters behaviour in fish

M.G. Bertram, Monash University / Biological Sciences; M. Saaristo, J.M. Martin, T.E. Ecker, C.P. Johnstone, B.W. Wong, Monash University / School of Biological Sciences

The evol...
The capacity of pharmaceutical pollution to alter behaviour in wildlife is of increasing concern to the scientific community. A major pathway of these contaminants into the environment is the treatment of livestock with hormonal growth promotants (HGP)s, highly potent veterinary pharmaceuticals that can enter aquatic ecosystems via effluent runoff. Hormonal growth promotants are designed to have biological effects at low doses, often act on physiological pathways that are evolutionarily conserved across species, and have repeatedly been detected in ecosystems worldwide. However, despite being shown to cause altered development, reproduction and morphology in various non-target species, relatively little is known about the potential of HGP{s} to alter ecologically important behaviours, especially across multiple contexts. Here, we investigated the effects of short-term (24 h) exposure to field-detected levels (in-farm and in-stream concentrations; 16 ng/L of 17β-trenbolone—a potent growth-promoting veterinary pharmaceutical repeatedly detected in freshwater systems—on a suite of ecologically important behaviours in female eastern mosquitofish (Gambusia holbrooki).

We found that fish exposed to 17β-trenbolone were more active and exploratory in a novel environment (i.e. maze arena), while boldness was not significantly affected. Further, when tested for sociability, exposed fish were again more active and exploratory, and spent less time associating with a shoal of stimulus (i.e. unexposed) conspecific females. Lastly, when assayed for foraging behaviour, exposed fish spent a greater total amount of time within a foraging zone containing an array of prey items (chironomid larvae) than did unexposed fish, entered this zone more frequently, and were more likely to feed. Further, a slighting rate of chironomids on three microalgae species, independently. Therefore, two diatom species, Gomphonema gracile (two different morphotype: normal (GG) and teratogen (GT)) and Planothidium lanceolatum (PL), and one green alga Pseudokirchneriella capricornutum (PS) were offered as food, during 24 h. Protein and lipid contents in microalgae were analysed subsequently. Each pesticide condition elicited a different grazing rate in chironomids with regards to algal species and the nutritional quality, with a general preference for Gomphonema gracile with teratogen shape and Pseudokirchneriella capricornutum. In a second experiment (cafeteria), food selectivity of chironomids was determined under similar contamination conditions during 4 h: Under diuron, larvae switched equally among microalgae, then were as mobile as in the control without pesticide. However, inidirocidal and the pesticide mixture condition altered chironomids’ movements and grazing behaviour. In these experiments, we highlighted that chironomids feeding behaviour and food preferences are impacted by pesticides. Herbicide and insecticide exposure, alone or in combination, had contrasting effects on grazing, both directly on the larvae or indirectly (food selectivity according to its quality). There was no such reduction in mortality of salmon individuals and as such important for population persistence as mortality intensity is believed to be adapted to the environmental conditions of the river in question. The overall finding of recent studies suggests that effects of pharmaceutical contamination of natural systems might be much more widespread than we predict based on conventional ecotoxicological tests.

Can personality influence the response of fish to environmental contaminants?

M. Oliveira, University of Aveiro; M. Sampaio, T. Santos, University of Aveiro / Biology Department & CESAM; A.L. Machado, University of Aveiro / CESAM Department of Biology; M. Barbosa, Department of Biology & CESAM - University of Aveiro / Biology; I. Domingues, University of Aveiro / CESAM Department of Biology

Stress is a determinant factor reducing animal welfare. Currently, it is recognized that animals react differently as a function of their personalities, or stress coping styles (i.e. consistency in behavioural and physiological responses across time or contexts). However, the role of personality in modulating individual response to environmental contaminants has received limited attention, despite the recognition that personality traits associated with a shy-bold continuum play an important role in animal fitness. Knowing that pharmaceuticals can interfere with personality, one question arises: what is the role of personality on animals’ response to pharmaceutical compounds? In this research, we defined the stress induced according to their survival and mortality of salmon individuals and as such important for population persistence as migration intensity is believed to be adapted to the environmental conditions of the river in question. The overall finding of recent studies suggests that effects of pharmaceutical contamination of natural systems might be much more widespread than we predict based on conventional ecotoxicological tests.

Effects of fluoxetine on anxiety-related behaviours and physiology in a songbird

S.E. Whitlock, Environment Department, University of York / Environment; R. Shore, Centre for Ecology & Hydrology (NERC); J. Lane, Animal and Plant Health Agency; K. Herborn, Newcastle University / Centre for Behaviour and Evolution; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; K. Arnold, University of York / Environment

Several species of bird are known to forage directly on invertebrates at wastewater treatment plants (WWT{s}), representing an exposure route to a range of contaminants including pharmaceuticals. The selective serotonin reuptake inhibitor (SSRI) fluoxetine is heavily used in human medicine and has been identified as a potential route of exposure to WWT{s}. Since fluoxetine is commonly prescribed for anxiety, we hypothesised that the antidepressant could modulate anxiety behaviour and physiology in exposed birds. Anxiety is an important state which arises in response to a real or perceived threat, enabling the individual to respond appropriately. Contaminants with the potential to alter anxiety-related behaviours are thus of concern to wildlife. We conducted a study which investigated the effects of exposure to environmentally relevant concentration of fluoxetine in a model songbird, the Eurasian starling (Sturnus vulgaris). We used a combination of behavioural and physiological endpoints to assess the effects of fluoxetine, specifically: 1) object neophobia, 2) exploration in a novel environment, 3) activity levels, 4) faecal corticosterone (CORT) metabolite concentration; and 5) leg skin temperature. Compared with pre-treatment data, fluoxetine-treated birds became less neophobic on average after six weeks dosing, indicating a decrease in anxiety behaviour. There was no such reduction in neophobia in the control group. After six weeks of dosing, control birds became more active on average but fluoxetine-treated birds showed no increase in activity.

Acknowledgements: This work was funded by the EPSRC. We thank the staff at the Centre for Behaviour and Evolution for assistance with the experiments.

Effects of pharmaceuticals on behaviour in aquatic systems

G. Hellström, Swedish University of Agricultural Sciences SLU; J. Klaminder, Umea University / Ecology and Environmental Science; F. Finn, Umea University; A. Lagesson, Umea University / Department of Ecology and Environmental Science; M. Jonsson, Umea University; J. Fick, Umea University / Department of Chemistry

Farm animals consume more pharmaceuticals than ever and consumption is set to rise. As a consequence, increasing amounts of pharmaceuticals are released into waterways worldwide with virtually no knowledge of how they might affect aquatic ecosystems. Some conspicuous effects of these emerging contaminants are already evident including the feminization of fish by contraceptive residue. However, recent work suggests that important effects of pharmaceuticals in aquatic environments are much more widespread than currently believed, and that these effects may result in major changes in species interactions, population survival and ecosystem functioning. In several earlier laboratory studies, we have shown that concentrations of pharmaceuticals presently found in waterways alter important behavioural traits in both aquatic macroinvertebrates and fish, and that this in turn affects both feeding efficiency and predation risk. These results suggest that pharmaceutical contamination of aquatic environments may change species interactions, in particular predator-prey interactions, with severe ecosystem-effects as potential consequence. Recently our research focus has turned towards realistic large-scale studies in lakes and rivers using acoustic telemetry to test if findings from the lab also hold in natural settings. Here I present results from one such study comparing effects of environmental levels of the anxiolytic pharmaceutical Oxazepam on migration pattern of Atlantic salmon (Salmo salar) in the lab and the field. In the lab, salmon exposed to the drug migrated approximately twice as fast as unexposed salmon and the subsequent field-study generated similar results, validating the results found in the lab. This pharmacologically induced change in migration-intensity has the potential to be a key determinant between survival and mortality of salmon individuals and as such important for population persistence as migration intensity is believed to be adapted to the environmental conditions of the river in question. The overall finding of recent studies suggests that effects of pharmaceutical contamination of natural systems might be much more widespread than we predict based on conventional ecotoxicological tests.
indicating increased lethargy in the fluoxetine birds relative to controls. There was no clear effect of treatment on exploratory tendency. Finally, infrared thermography showed that fluoxetine-treated birds had significantly colder legs compared with controls. This indicated that, as observed in humans, fluoxetine causes vasconstriction, which in birds will affect the ability to thermoregulate. This study provides further evidence that low, environmentally relevant concentrations of pharmaceuticals can cause sublethal changes to behaviour and physiology that are predicted to impair the capacity of wildlife to respond appropriately to environmental changes.

Can trends in wildlife populations revolutionise our understanding of the impacts of chemicals on the environment?

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Does single compound risk assessment protect from mixture effects and multiple stress?

P. Von der Ohe, UBA - Federal Environment Agency / IV 2.2 Pharmaceuticals

There is clear evidence that stress from anthropogenic activities can have profound local and regional effects on aquatic communities. To what extent chemicals are responsible remains widely unknown. The question whether a single compound risk assessment can protect from further deterioration of our water resources is discussed in the light of current mixture toxicity frameworks and multiple stress considerations. Here we present a European wide risk assessment of organic chemicals, based on regulatory monitoring data at about 6,000 monitoring sites available from the European Environment Agency (EEA). For the more than 600 mostly industrial substances, including many deterrent ingredients such as benzoisothiazol, the available quality standards were collated or predicted from reliable QSAR models. Results showed that organic chemicals are likely to exert long-term effects on sensitive species in more than 5% of the sampling sites with multi-year samplings. In this study, we analyzed the potential cumulative effects of multiple exceedances of the PNEC (predicted no effect concentration) of the chemicals expected. Hence, our assessment is likely to underestimate the actual risk. Nevertheless, the results show that multiple exposures at each site is neither the rule than the exception. Finally, we discuss whether chemicals from WWTP have significant effects on aquatic invertebrate communities as compared to effects from local habitat. For that purpose, we analysed two data sets on macro invertebrate communities where we have a) similar chemical stress, but differing habitat quality and b) similar habitat quality but differing chemical stress. The results indicate that in direct comparison, chemical stress induced larger effects as compared to habitat degradation. Our results therefore clearly indicate that chemical pollution is still a large-scale environmental problem that requires far-reaching, holistic mitigation measures to preserve and restore ecosystem health. It also suggests that current risk assessment approaches on a substance by substance bases are likely not protective for the environment.

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Threshold trends in wildlife taxa: challenging and evaluating our chemical- and environmental risk assessments of chemicals and their mixtures

L. Postuma, RIVM / Centre for Sustainability, Environment and Health; D. De Zwart, DiDZ Ecotoc / Centre for Sustainability Environment and Health; J. Postma, Ecofide; M.C. Zijp, RIVM / Centre for Sustainability, Environment and Health “Big data” are a potential goldmine for studying and contextualizing chemical and environmental risk assessments, as they enable relating predicted risks to observed impacts. This can confirm or challenge our chemical risk assessments, by checking whether Environmental Quality Standards provide sufficient safety, and whether or not mixture exposures cause problems not captured in the widely used ‘single-chemical plus safety factor’ approaches. Digging the goldmine asks for – first – data collation, and then: a powerful design which can be borrowed from epidemiology. This presentation is a recent gold-digging trial, with surprising results. We collated biomonitoring and mixture exposure data from the Dutch Waterboards, as collected due to obligations of regulatory frameworks (such as the Water Framework Directive). We quantified for each sample, based on measured chemical concentrations, the mixture toxic pressure at EC50-level. Outcomes were expressed as multi-substance Potentially Affected Fraction (mPAF-EC50) of specific species (Species Sensitivity Distribution (SSD)). Earlier research suggested that this proxy – higher values of which are interpreted to imply a higher potential for species loss – has a gross absolute relationship with species loss in various regional studies. In the current study, we overlaid the SSD-model basis (all species are unequal in their sensitivity to exposures) with this finding, by analyzing taxon-specific threshold values. That is, we determined the taxon-specific mPAF-EC50 beyond which species abundance starts changing when toxic pressure rises, in a downwards (sensitive) or upwards (indirect opportunistic response) direction. The results show a series of species-specific mixture exposure thresholds, and an overall assemblage-level (aggregated) exposure threshold. These outcomes are compared to simpler approaches, such as quantile regression on the species assemblage level, as well as multi-stressor statistics. We conclude that the set of species-specific and assemblage-level thresholds bear important contextual information to judge our risk assessment and management foundations, be it in the realm of prospective Chemical risk assessment or of the retrospective Environmental risk assessment and management.

How much do improved wastewater treatment benefit downstream macroinvertebrate populations?

A. Johnson, CEH Wallingford / Wallingford; F. Edwards, Centre for Ecology Hydrology Maclean Building; M.D. Juergens, Centre for Ecology and Hydrology / Wallingford; H. Vincent, Centre for Ecology Hydrology Maclean Building

The River Ray, which is a small tributary of the Thames (UK), offers an unrivalled opportunity to examine the impact of changes in wastewater treatment on the resident aquatic wildlife. This opportunity exists because the waste from the 170,000 plus people of Swindon discharges into this small 12 km long waterbody, such that the downstream mean annual flow is composed of 65-80% treated effluent. The downstream monitoring sites showed a sustained improvement in macroinvertebrate diversity starting from 1991 onwards. This sustained improvement for macroinvertebrates coincided with a 10-fold drop in ammonia, halving of biodegradable organics, (BOD) and improvement in dissolved oxygen associated with the conversion of the Swindon plant from trickling filter to nitrifying activated sludge. There were no dramatic changes in metal concentrations over the key early 1990s’ period unlike the main sanitary determinants. Whilst there was no change in overall flows, winter water temperatures downstream of Swindon rose over the course of the 30 year monitoring period. We could not identify health depends upon the macroinvertebrate community from the application of tertiary granular activated charcoal treatment (GAC) lasting from 2008 to 2014. No new macroinvertebrate families appeared during this period. The steady improvement in macroinvertebrate diversity in an effluent dominated river implies that current chemicals in domestic wastewater are not noticeably harmful to these organisms. This implied that provided we can achieve a 90th percentile BOD below 5 mg/l, NH4 below 0.6 mg/l and PO4 above 0.6 mg/l, this will result in a significant improvement in macroinvertebrate diversity will steadily improve (within the limits of habitat suitability). The small river has a population of stickleback and other fish but their changes in abundance are not known. The recovery of macroinvertebrate diversity is slow and has not yet returned to the expected range for such a river, however, it was noted that the habitat is not ideal. This project has demonstrated the immense power and value of consistent long-term parallel chemical and wildlife monitoring. Andrew C. Johnson, François Edwards, Monika D. Jürgens, Helen Vincent Centre for Ecology and Hydrology, Wallingford, Oxfordshire, OX10 8EB, UK ajo@ceh.ac.uk Keywords: macroinvertebrates, biodiversity, wastewater, GAC

Track 7, Session 7.2 Preference Platform

Biometric parameters of the bream (Abramis brama) as indicators for long-term changes in environmental quality - results from the German ESB

D. Teubner, Trier University / Biogeography; M. Paulus, M. Veith, Trier University; R. Klein, Trier University / Biogeography

Fish health depends upon the macroinvertebrate community from the application of prospective Chemical risk assessment or of the retrospective environmental risk assessment foundations, be it in the realm of prospective Chemical risk assessment or of the retrospective Environmental risk assessment and management.

The burden of being a slow-life cycle species: freshwater fish population dynamics in France, correlations to species life traits and implications in ecotoxicology

Sanne Hopia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; N. Poulet, Agence Française pour la Biodiversité / Pôle Ecorhizologique, ABF-IMFT; A. BESNARD, Centre d’Ecologie Fonctionelle et Évolutive / Biogéographie et Ecologie des Vertébrés Population dynamics of aquatic species and ultimately their population growth rates, must be known to properly define species conservation status and plan appropriate conservation strategies. It also essentially involves understanding how inter-specific variations in demographic and life history traits influence population dynamics. For this purpose, we implemented an integrative approach focused on 18 common freshwater fish species representing 94% of fish abundance and 88% of fish biomass sampled since 1990 in 546 monitored sites in France. Abundance and biomass growth rates were estimated with space state-models and fish length trends with quantile regressions. To further study correlations between fish abundance, biomass, fish-length trends and fish life traits (life history strategies, species trophic position, habitat preferences and thermal tolerance) we performed multivariate analyses. The present work demonstrates that during the last decades, 10 species
exhibited significant decline in abundance, 2 species were in expansion and fish abundance remained stable for 6 species. The correlation between biomass and abundance growth rates was also very high (R²=0.93). The intra-specific trends in fish length over the studied period also showed a severe decrease among the largest individuals (quantile 0.75 and 0.90) and was correlated to severe biomass decline in several species. This result reflect progressive alterations in the population size / age structure suggesting that a decrease in growth and survival might be responsible of the population decline. Among the demographical and ecological traits we investigated, generation time and fish maximum length were the most correlated to species population growth rates indicating the decline of slow generation time species. These results are discussed with regards to global pressures which could explain large scale decline of periodic species with a focus on chemical pollutants for which we explain body growth decrease, juvenile and adult survival alterations due to micropollutant exposures. Further attention will be paid to discuss conservation measures and life stages which should be protected in priority to favor periodic species recovery.

211 The use of natural historical collections to reconstruct temporal trends of the exposure to major contaminants in different white-tailed eagle (Haliaeetus albicilla) populations

J. Sun, Antwerp university / Department of Biology; J.O. Bustnes, Norwegian Institute for Nature Research / Fram Centre; A. Covaci, University of Antwerp, Toxicological Centre / Toxicological Centre Dept of Pharmaceutical Sciences; B. Hipsu, S Swedish white-tailed eagle Monitoring; G. Malarvannan, University of Antwerp / Toxicological Centre; J. Sondereggaard, Aarhus University / Arctic Research Centre; K. Thorup, A. Totrup, Natural History Museum of Denmark; M. Eens, University of Antwerp / Department of Biology; I. Eulaers, Aarhus University / Department of Bioscience

Understanding temporal trends of persistent contaminants in wildlife is critical for the assessment of the pattern associated past, present and future health risks. We have established a retrospective examination of mercury (Hg) and several organic contaminants (OHCs) in Swedish, Norwegian and Greenlandic white-tailed eagle (Haliaeetus albicilla) using body feathers obtained from natural history and ornithologist collections. We analyzed feathers for Hg, polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs), as well as stable carbon and nitrogen isotopes. The aims of the present study were: 1) to retrospectively reconstruct temporal trends of major contaminants in relation to anthropogenic emissions and regulations, 2) to interpret how dietary habits (using stable isotope proxies) may have affected the temporal trends, and 3) to document a potential spatial gradient from high (Sweden) to low (Greenland) anthropogenic contaminant input. Strong evidence for spatiotemporal patterns was found based on preliminary results for Hg and OHCs in the Swedish and Norwegian populations. Swedish white-tailed eagle feathers showed concentrations associated with adverse physiological effects, thus supporting the earlier observed dramatic decline in productivity. Hg concentrations were much lower in the Norwegian feathers, while the peak PCB exposure is of the same order of magnitude as the average PCB exposure in Swedish white-tailed eagles (H. albicilla) (median = 3.29 ng g⁻¹). Clear declining trends were observed for both the Swedish and Norwegian time series after 1970s. We did not detect PBDEs before 1970 in the Swedish or Norwegian time series, although concentrations increased steeply during the 1980s, decreasing trends were observed afterwards. Hg concentrations in the Greenlandic time series were stable before 1940, but showed an increasing trend from 1980 to 2013. These results suggest that changes in historical and recent anthropogenic emissions strongly shape temporal changes of persistent contaminants in avian top predators. In addition, the relative interplay between local versus long range transport have likely affected the spatial pattern of contamination levels. The here presented preliminary results will be complemented with data for the Greenlandic populations as well as emission and stable isotope data to disentangle the relative effects of dietary habits and anthropogenic contaminant sources.

Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (I)

212 Findings of a SETAC Technical Workshop on Bioavailability-based Water Quality Criteria

C.E. Schlekat, NiPERA; K. Gallagher, U.S. EPA / Office of Water; B.A. Stubbfield, Oregon State University / Environmental and Molecular Toxicology A workshop entitled “Technical Workshop on Bioavailability-based Water Quality Criteria” was held under the auspices of the Society of Environmental Toxicology and Chemistry on 3-8 December 2017 in Pensacola, Florida, USA. The goal of the workshop was to evaluate the state-of-the-science regarding metals bioavailability models and their use from a regulatory perspective. A second, but equally important, goal was to provide a scientific forum for discussions that could inform the further incorporation of bioavailability concepts into regulatory approaches for determining aquatic life criteria. The goal was to provide a state-of-the-science regarding the ability to accurately predict the toxicity of metals in the environment to aquatic organisms has increased rapidly in recent years. Workshop participants reviewed the current state-of-the-science on aquatic bioavailability information for metals and on methods to model bioavailability under a range of environmental conditions. Participants also discussed the technical challenges associated with applying bioavailability-based approaches, especially in a regulatory context. The outcome of the workshop will support expansion incorporated of metal bioavailability information into global regulatory frameworks. Approximately 40 invited scientists representing industry, government, and academia participated in the workshop. Participants were divided into five groups with each group addressing one of the following meeting objectives: Review of the state-of-the-science regarding the issue of metal bioavailability and toxicity to aquatic organisms, Determine the extent to which available biotic ligand models (BLM)/multi-linear regression (MLR)-based models/or other alternative approaches offer a means to incorporate bioavailability into toxicity models and how they are protective of aquatic life. Develop technical information regarding the type and quantity of data necessary to develop and apply bioavailability-based aquatic toxicity models, Develop recommendations for approaches to validate bioavailability-based models, and Provide recommendations for suggested measures of acceptability for bioavailability-based aquatic effects models. Workshop findings will be presented and will later be published in the form of a SETAC “Summary document” and a series of manuscripts to be submitted to a SETAC journal.

213 Modifying factors for nickel speciation and toxicity in seawater

W. Chen, Wilfrid Laurier University; S. Sherman, Wilfrid Laurier University / Biology; J. McGeer, Wilfrid Laurier University / Department of Biology; R.C. Santore, Windward Environmental, LLC; T. Blewett, University of Alberta; G. Merrington, WCA Environmental Limited; D. Smith, Wilfrid Laurier University / Department of Chemistry

Nickel (Ni) toxicity in seawater is of increasing concern because of coastal Ni mining and associated activities. Determining Ni speciation is vital to understanding and predicting Ni toxicity and ultimately for bioavailability-based nickel risk assessment. Application of existing freshwater bioavailability based approaches for nickel in salt water predicts negligible binding of Ni to dissolved organic matter, but there are several examples of toxicity tests in natural seawater that are protective compared to artificial seawater control samples. Determining Ni speciation was found in natural seawater samples of diverse geographic origin from the east coast of the United States and Canada. The divalent Ni free ion in these synthetic and real seawater samples was quantified using Ion Exchange Technique (IET) with Ni measured by Graphite Furnace Atomic Absorption (GFAA). The measured Ni²⁺ values were compared with model predictions (i.e. Visual Minteq) for evaluating the feasibility and applicability of the IET method for Ni in seawater. For the most part IET-measured [Ni²⁺] agreed very closely with model predictions. In the defined solutions, 96-hour Ni embryo toxicity tests were performed for a sea urchin (S. purpuratus). The dose response curves were expressed both as total dissolved Ni concentration ([Ni]) and free Ni concentrations from IET ([Ni²⁺]). If the Ni toxicity is explained by [Ni²⁺], all the toxicity response curves of different model ligands will overlap and this was fact observed for the majority of samples. The results of this research contribute to the development of bioavailability-based prediction models for estimating the impacts of Ni in marine water. Funding was provided by Natural Sciences and Engineering Research Council of Canada (NSERC), Vale Canada and NiPERA Inc.

214 Acute bioavailability models for nickel: Development and regulatory application

K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology; P. Van Sprang, I. Vercagne, ARCHE; A. Peters, wca; C. de Schamphelaere, K. NiPERA; E. Schlekat, NiPERA / Ecotoxicologist

Chronic bioavailability models for nickel are well-established. For example, the Annual Average Ni Environmental Quality Standard (AA-EQS) under the European Union's (EU) Water Framework Directive (WFD) is based on normalization of chronic Ni ecotoxicity data using chronic Ni bioavailability models. Acute Ni models have been developed for invertebrates, fish, and algae, but are not adequately received less attention. The aim of this project was to investigate whether given that acute Ni toxicity can vary by greater than 17-fold for aquatic invertebrate species tested in variable water chemistries, normalization of acute Ni ecotoxicity data is an important consideration for the determination of Maximum Allowable Concentrations (MAC) under the WFD. The goal of this study was to test if the existing acute Ni bioavailability models can be used to predict acute Ni toxicity to both model and non-model species and to demonstrate how they can be applied to derived MAC values. Acute Ni ecotoxicity data (eight species from 13 different studies) were identified from the literature. Data were accepted for analysis if acute Ni toxicity for a species was tested in >2 test waters differing in physico-chemistry.
Acute Ni bioavailability models (3 invertebrate models, 2 algae models, and 1 fish model) were used to evaluate the ecotoxicity data. To simplify the normalization process, an “average animal” bioavailability model was developed using a weighted average of parameters for existing models. Because crustaceans are typically among the most sensitive organisms to Ni exposure, and because the fish model did not capture effects on acute Ni toxicity to crustaceans very well, an “average crustacean” model was developed. The model parameters for the 3 crustacean models were combined to construct the “average crustacean” model. Both the “average animal” and “average crustacean” models reduced intraspecies variability considerably among the available Ni ecotoxicity data. For example, the “average animal” model predicted 98% of the 193 individual acute ecotoxicity data points within a 3-fold error, and 90% within a 2-fold error. The “average crustacean” model although this model clearly showed a better ability to predict the effect of pH on Ni toxicity to cladocerans. The models were applied to an acute Ni ecotoxicity dataset to derive bioavailability-based MAC for European water bodies with typical ranges of water chemistry.

215 Bioavailability and bioaccumulation of uranium: From lab experiment to modelling A. Husson, Mines ParisTech / Hydrodynamics and reactions team (HR); M. Leermakers, Vrije universiteit Brussel / Department Analytical, Environmental and Geochemistry; M. Descostes, AREVA Mines / R&D; V. Lagneau, Mines ParisTech PSL Research University FGeo (BIOEST) / health of aquatic and terrestrial organisms (HR); Environmental regulations are becoming more and more ecosystems-oriented. In this respect, the habitat’s faunal biodiversity is targeted, meaning the contaminant’s bioavailability is taken into account. The latter depends on the geochemical conditions of the aquatic system, which define the chemical speciation. For several elements, Environmental Quality Standards (EQS) and Sediment Quality Standards (SQS) have been proposed. For non-priority elements such as Uranium, EQS and SQS should be supplemented with national standards. As the bioavailable fraction in sediments is dependent on geochemical factors and sediment mineralogy, it is important to investigate the role of sediment composition on the bioaccumulation of uranium in benthic organisms. In the present study, laboratory experiments were performed on the bioaccumulation of uranium in the larvae of the non-biting midge Chironomus riparius exposed to specific mineralogical phases (pure Quartz (Q), 10% Kaolin/90% Q, 10% Smeectite/90% Q, 10% Ferrhydrite (FOH)/90% Q and a mixture of the 4 mineral phases (3.3% Kaolin/3.3% Smeectite/3.3% (FOH) and 90% Q) spiked with uranium at two different concentration levels. During a ten-days exposure experiment, the uptake of uranium in the chironomid was investigated and the concentrations of uranium in sediment, overlying water, pore water were measured as well as the composition of major ions and physicochemical parameters. Diffusive Gradients in Thin Films (DGT) devices were deployed simultaneously to investigate the relationship with the uptake of uranium in the chironomid larvae Sediment to porewater partition coefficients (Kow) range from 10 L/Kg for quartz to 60000 L/Kg for FOH. After ten days exposure, the highest Biota Sediment Accumulation Coefficient (BSC) of uranium was found for (10% ferrhydrite) (9) and Smeectite (8) and is the lowest for the mixed composite sediment (1). DGT labile uranium porewater concentrations account for 70-100% of the uranium in porewater for all mineral phases except the quartz, where CDet only accounts for 10% of the uranium in porewater. Uranium accumulation on the DGT units is correlated with the accumulation in the chironomids. Results obtained by these experimental procedure is in line with code (CHESS) to model the uranium sorption behaviour and chemical speciation in the aqueous phase. These results are comparable with the proposed regulations by IRSN on uranium bioavailable chemical species.

216 Empirical Investigations into the Toxicity and Bioavailability of Aluminium to Aquatic Species B.A. Stubblefield, Oregon State University / Environmental and Molecular Toxicology; A.S. Cardwell, Oregon State University / Faculty Research Assistant; W.J. Adams, Red Cap Consulting; R. Genser, GEI Consultants / Ecological Defence Group; R.C. Santore, Windward Environmental, LLC; E. Nordheim, Aluminium REACH Consortium Implementation of the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) regulation over the past years has resulted in: 1) the generation of large amounts of empirical toxicity data and 2) increased our understanding of the relationships between water physicochemical parameters and algal toxicity. This has put a requirement on the provision of data describing the chronic toxicity of regulated chemicals to a variety of aquatic organisms. To address possible data gaps in the Al database, a series of chronic toxicity tests conducted with predictive models based on decision trees, to discriminate those environmental factors responsible for the environmental degradation observed in rivers and streams in the study area. In order to determine the environmental quality of the sites visited, the application of the BMWP / Col index was used, which is based on the structure of the macroinvertebrate community present. Additionally, a set of environmental variables of water and sediment quality were used as additional models for the prediction of the pressure of the activities carried out in the basin, which is predominantly dedicated to the extraction of gold. Artisanal gold mining in the Ponce Enríquez area is a social technical problem that is affecting aquatic ecosystems and the ecosystem services they provide. The main stressors of the deterioration of the ecological quality of the rivers studied are calcium, copper, the total suspended solids and the modification of the water stressors of the deterioration of the ecosystem. The irreversible effect of the environmental factors responsible for the environmental condition of the rivers studied are industrial, agricultural, mining and urban development activities have in many cases led to the generation of pollutant discharges that threaten the health of our ecosystems. The impacts of mining activity on aquatic ecosystems have been widely documented, reporting the deterioration of water quality, the impact of biodiversity, as well as the release of heavy metals of potential accumulation in organisms and subsequent biomagnification through the food chain. Although it is known that non-technical mining activity affects the environment, it is necessary to identify and prioritize those factors related to mining activity that have a greater impact on the ecosystem (e.g. extraction, cyanidation, amalgamation). The identification of these factors would allow environmental control authorities to prioritize management actions focused on those parameters with the greatest impact, thus mitigating the impact of this activity on aquatic ecosystems. To illustrate this, the present study conducted in the Ponce Enríquez area seeks, through the construction of predictive models based on decision trees, to discriminate those environmental factors responsible for the environmental condition observed in rivers and streams and size of the stations sampled. (Ca)

Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (I) 218 Closing the gap between small and smaller: Towards a framework to analyse nano- and microplastics in aqueous environmental samples P. Bauerlein, KWR / Analytical and Environmental Chemistry; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; S. Mintenig, Utrecht University / Copernicus Institute of Sustainable Development; A. Koelmanns, Wageningen University / Aquatic Ecology and Water Quality Management; H.M. Oehlendorf, CHEM

Detecting microplastics and determining actual concentrations and sizes of plastic particles present in the environment is essential to assess the risks that are posed by plastic particles. Microplastics have been detected globally in various aquatic ecosystems. The determination of microplastics is hampered by the high methodological challenges. But yet, its formation was proven experimentally and, for the first time, its presence in marine surface water samples confirmed. Building on those results, we further propose a framework that is able to consistently determine a broad size spectrum of plastic particles in an aqueous environmental sample. The results from initial tests confirm the general applicability of individual techniques to, firstly, sample and, secondly, detect plastic sizes and polymer types. To obtain representative results, a sampling strategy is needed to concentrate plastic particles. Crossflow ultrafiltration is applied to concentrate nanoparticles from 100 into 0.5 L and yields in a reproducible particle recovery of 54 ± 2 %. Microplastics are detected using FTIR-microscopy which is limited to a minimum particle size of 28 µm. For nanoparticles field- flow- fractionation, that reveals information on the particle sizes, and pyrolysis GC-MS, that is used to identify the polymer types, are
applied. Under the given settings the latter requires a mass of approximately 100 ng to identify polystyrene in an environmental sample by which this technique seems promising for the detection of nanoparticles. The pre-concentration by cross-flow ultracentrifugation reduces the determined detection limits, and enables the identification of polystyrene for an original concentration of 20 µg L⁻¹ in aqueous samples. Finally, we propose an approach to estimate polymer masses based on the two-dimensional microfluidic approach using the analysis with FTIR-microscopy. By this, the results of spectroscopic and thermal degradation analyses (e.g. pyrolysis GC-MS) can be combined and compared.

219 Trace particulate plastic analysis in environmental systems: synthesis and utility of metallic fingerprint and microplastic particles and fibres.

F. Schmidt, M. Schmiederer, Eawag Swiss federal Institute of Aquatic Science and Technology; D.M. Mitrano, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Risk and Management Research on particulate plastic (nano- and microplastic particles and fibers) and their distribution in the environment has intensified in recent years; but truly quantitative analyses, even at the bench scale, have remained elusive in particular due to the analytical difficulties in detection. Synthesizing plastic particles with a metallic, chemically entrapped tracer can provide a robust way to more easily, accurately and quantitatively detect particulate plastic in complex environmental and biological media. In this study, a suite of methods to synthesize a variety of particulate plastics of various sizes (100 nm to 1 mm), surface morphologies/charges and polymers (polystyrene, polyester, polypropylene and low density polyethylene). Each variant has an embedded metallic fingerprint (Pd, In, Au; approximately 0.5% metal/wt) which can be used to detect plastic by common analytical techniques, such as ICP-MS. To highlight the utility of this approach, dilute concentrations of particulate plastic were measured in various media including river water, municipal wastewater treatment plant effluent and wastewater sludge. Nanoplastics, for example, were detected three orders of magnitude lower than equivalent concentrations than similar particles with a fluorescence label. After ensuring the metal tracer was stable over time, digestion methods were developed which took into consideration the specific polymer and metal in question to achieve a minimum of 85% recovery in every matrix. Furthermore, the particulate plastics synthesized were spiked into mixed liquor in batch experiments, representing different stages of a municipal wastewater treatment plant to determine how various particulate plastics move through the system. In this way, some conclusions could be drawn concerning particle behaviour, aggregation and the likelihood of microplastics and the potential for microplastics to be discharged to freshwater within wastewater treatment effluent. Beyond the case study specifically highlighted here, these metal laden particulate plastic particles can be used as a potential tracer or surrogate for microplastics such as the case study specifically highlighted here. However, until now, there are no established quality assurance concepts for the analysis of microplastic (< 5 mm) in environmental compartments, including sampling, processing and analysis [1-4]. The aim of the present work is the development of suitable examination methods and protocols (sampling, sample preparation and detection) to qualify and quantify microplastic in urban water management systems. At first a fractional filtration system for sampling and the analytical tool, the so-called TEC- GC-MS (thermal desorption gc-based mass spectrometry) and FTIR was developed. The developed method is a two-step analytical procedure which consists of a thermal extraction where the sample is annealed and characteristic degradation products of the polymers are collected on a solid phase. Afterwards these products are analysed using GC-MS [5]. The developed fractional filtration for sampling and the GC-MS method for detection were used for quantitative analysis to screen the waste water influent and effluent of a Berlin waste water treatment plant for the most relevant polymers, polyethylene (PE), polypropylene (PP), polyethylene (PS), polyethylene terephthalate (PET) and polyamide (PA). The results of the study revealed that the polymers PE, PS and PP were detected in the effluent, and PE and PS were not detected in the raw waste water of the sewage treatment plants in Berlin. Differences in polymer types and amounts were detected at different sampling dates and within different sieve fractions. Much higher amounts of polymers were observed in the raw waste water. The peak areas of the decomposition products, used for quantification of the polymers, were adjusted using so-called response factors since the TEC-GC-MS method is more sensitive for PP and PS than for PE. It has been shown that PE is the most dominant polymer in the samples. Comparing the masses of polymers in the effluent and in the raw sewage, a removal of 97 % of the polymers in the water treatment plant can be assumed. These results are consistent with the literature where removal rates between 98-99 % were described [6-7].

221 Soil and sludge: A time and cost-effective method for extracting microplastics from complex, organic-rich environmental matrices

R. Hurley, NIVA - Norwegian Institute for Water Research; A. Lusher, NIVA Norwegian Institute of Water Research / Marine and Freshwater Research Centre; M. Olsen, Telemark University College; L. Nizzetto, NIVA These results highlight the very little existence of microplastics in organic-rich substrates such as soil or sewage sludge. The organic components, as well as the complexity of the solid matrix, complicates the extraction process. No standardised methodology has thus far emerged. This study aims to establish an effective extraction technique appropriate for the monitoring of microplastic contamination in soil and sludge samples. Four main protocols (including two temperature and concentration variants) were tested for the removal of organic material followed by a density separation process. This approach was selected to afford comparability with existing sediment microplastic analyses. The selected reagents were: peroxide oxidation (60°C, 70°C), Fenton’s reagent, NaOH (1 M, 10 M) and KOH. The methods testing procedure was split into three phases: 1. Effect of reagents on test polymers; 2. Efficacy of reagents in reducing organic matter content in soil and sludge; and 3. Extraordiary surveying the incorporation of samples including density separation. 7 reference polymers were used: HDPE, LDPE, PP, PS, PET, PC and PA-66, which account for >70% of global plastic demand. Degradation was observed for several of the reagents and selected polymers. NaOH treatments caused the most significant changes, including degradation of PET and PC. Small degradative changes occurred as a result of peroxide oxidation and KOH treatments. Fenton’s reagent and KOH treatments were not effective in sufficiently reducing organic material whilst peroxide oxidation and Fenton’s reagent removed the majority of organic material. Based on these results, Fenton’s reagent was identified as the optimum treatment and was further optimised. Phase 3 tested revealed high extraction efficiencies for this protocol. This phase of the study is a time- and cost-effective approach suitable for application in routine monitoring of complex environmental substrates whilst facilitating the collection of important particle information.

222 Mapping microplastics in sludge during a country-wide investigation of wastewater treatment plants in Norway

A. Lusher, NIVA Norwegian Institute of Water Research / Marine and Freshwater Research Centre; R. Hurley, Norwegian Institute for water research; M. Olsen, C. Vogelsang, NIVA Norwegian Institute for Water Research Incorporation of anthropogenic particles into sludge has been highlighted as a major route for the transport of pollutants into the environment. Here we present the results of a nationwide survey investigating the incorporation of microplastics into sludge from domestic wastewater treatment plants which operate different wastewater treatment technologies. The main objective of this project was to characterize, map and compare results between different types of wastewater treatment plants. Samples were extracted using organic matter matter followed by a density separation procedure following. Plastics were identified in sludge samples from all treatment plants investigated. The overall average microplastic concentration was 6.077 particles kg⁻¹ (d.w.) (1701 – 8393) or 1 176 889 particles m⁻³ (370 – 8393 274). Particles from sludge consisted of beads (37.6%), fragments (31.8%) fibres (28.9 %) and glitter (1.7 %). Most of the particles were clear in colour (41%). Ten percent of the overall particles extracted were tested using FT-IR. All particles (n= 60) were confirmed to be plastics. Polyethylene particles were the most common (30.5%) followed by polyethylene terephthalate (26.7%) and polypropylene (20.3%). 62% of plastics were extracted at high density (1.8 g cm⁻³) separation steps and 38% were extracted at high density (1.8 g cm⁻³). Results between WWTPs were highly variable and there was no clear difference between average microplastic concentrations across the different treatment plant technologies. Based on this study and the routine analysis of sewage sludge in Norway, it can be estimated that approximately 446 million microplastic particles are spread on agricultural soils, 27 billion microplastic particles are added to green areas and 112 billion microplastic particles are sent to soil producers per year. This equates to over 584 billion microplastics that are released into the environment via sewage sludge application each year in Norway.

223 The Influence of Weathering on the Sinking Behavior of Microplastic in Freshwater and all Surface Waters

H. Arg, NGI / Environmental Technology; L.B. Olsen, D. Issler, NGI; N. Berrogaibuz, NGI / Environmental Chemistry; S. Wongsoedjo, X. Shen, E. Toorman, KULeuven Key to understanding the fate of microplastic particles in fresh water are the changes they undergo as a result of various weathering processes, like biofilm growth, aggregation, UV exposure and physical stress. Some of these weathering...
processes may cause changes in the density and shape of individual plastic particles, or aggregates. This can be a driving factor for the ultimate fate of microplastic, as it could cause floating microplastic to sink or be suspended below the water surface. However, the factors controlling the buoyancy or sinking velocity of different microplastic are not as well-known as they are for other particles/particulates, like phytoplankton and sedimentary material. Herein we present the results of linking experiments on the microplastic, covering different shapes (spheres, flat, irregular), microplasticatty, because they are dispersed under different water properties, considering a range of ambient conditions (temperature, salinity and turbulence). The microplastic were compared before and after exposure to weathering processes in the lab and outdoors. The results obtained in this sinking experiment were compared to theoretical expectations, based on literature equations that describe the relationship between the drag coefficient and particle Reynolds number. A key advantage of this relationship is that it is independent on the type of plastic and properties of water, and would therefore apply to both freshwater and saline water alike, as it would to all types of microplastic.

Air Pollution, Biomonitoring and Human Health (I)

224 Particulate matter in indoor academic environments: chemical composition, sources, infiltration from outdoor L. Tofoli, CNR / Institute of Atmospheric Pollution Research; S. Canepari, Sapienza University of Rome / Chemistry; M. Catrambone, F. Marcovecchio, M. Giusto, CNR / Institute of Atmospheric Pollution Research; S. Pareti, CNR / institute of atmospheric pollution research; T. Sargolini, CNR / Institute of Atmospheric Pollution Research; C. Perrino, CNR Institute of Atmospheric Pollution Research Institute of Atmospheric Pollution Research.

We present the results of the first part of an experimental study carried out in an environment with variable parameters including the presence/absence of the students, season. Two type of sampling schedules were applied. The first one differentiates among working days, nights and week-ends during a 6-week winter period and a 4-week summer period (Special Observation Periods – SOPs). This schedule was planned to highlight the differences due to the presence of the students and teachers. The second one (Long-Term Sampling) consists in twelve 1-month PM$_2.5$ samples carried out by using very-low flow-rate samplers. It was envisaged to obtain a general picture of the effect of the above parameters during a whole calendar year. Both sampling schedules were applied to six indoor and four outdoor sites, all inside or around the same building. At each site and for both schedules the sampling were simultaneously carried out on Teflon, quartz and polycarbonate filters. Teflon filters were used for the determination of the collected mass (by gravimetry), of the elemental content (total content by energy dispersion X-ray fluorescence, bioavailable and residual fractions by inductively coupled plasma mass spectrometry), of anions and cations (by chromatography), of elemental and organic carbon (by thermo-optical analysis) and of the bioaerosol content (by propidium iodide staining and epifluorescence microscopy). The Long-Term Sampling was performed in 12-month PM$_2.5$, such industrial sources were the main contributors of metals at the two sites.

225 Source apportionment of major species and metals in PM$_2.5$ in urban sites under industrial influences in northern France E. Ledoux, University of Littoral Côte d’Opale / Unité de Chimie Environnementale et Interactions sur le Vivant UCEIV EA4492; A. Kfoury, University of Balamand / Institute of Environmental Sciences; G. Delmaire, University of Littoral Côte d’Opale / Laboratoire Informatique Signal de la Côte d’Opale LISIC EA4491; G. Rossolet, University of Littoral Côte d’Opale / Unité de Chimie Environnementale et Interactions sur le Vivant UCEIV EA4492.

PM$_2.5$ have been related to various adverse health effects, mainly due to their ability to penetrate deeply and to convey harmful chemical components inside the body. The fate of PM$_2.5$ in the air is one of the most densely populated area in Europe and is known as an industrialized region especially in the field of metallurgy, organic chemistry, and glassmaking. Furthermore, its strategic position in the heart of Europe means that this area is subject to major transportation activities by road and also by sea. In this context, the objective of this work was to acquire a better knowledge on the exposure level to major species and metals in PM$_2.5$ and on the identification of their sources in urban sites influenced by particulate emissions from anthropogenic sources. Sampling was performed using 2.50 mm diameter high volume samplers between November 2010 and April 2011 in three medium cities located in northern France, Dunkerque (Dk, coastal urban and industrial site), Boulogne-sur-Mer (BL, coastal and urban site) and Saint-Omer (ST, inland urban and industrial site). PM$_2.5$ composition was analyzed for major elements, trace elements, reactive species and some organic compounds, respectively. Species concentrations were examined according to different ways including temporal evolution, concentration and pollution roses. The impact of such sources on major species and metal concentrations in PM$_2.5$ was then quantified using a weighted non-negative matrix factorization based receptor model that considers constraints on chemical profiles (CW-NMF). NO$_2$, SO$_2$, NH$_4^+$ and TC were found as the major contributors of PM$_2.5$ (between 93% and 95%) and they were the main differences were evidenced. Trace elements (Cr, Zn, Ni, As, Ag, Cd, Cu, Mn, Pb, V, Sn, Rh, Sr, Bi, Ba, Co, Sb and Ti) only correspond to 0.30% to 0.45% of the PM$_2.5$ mass according to the sites. The CW-NMF model identified 8 common source profiles at the 3 sites: secondary nitrates, residential and road traffic, secondary sulfates, fresh and aged sea-salts, heavy fuel oil combustion, non-exhaust traffic and crustal. In addition, 4 industrial source profiles were identified in Dk and sulfuric aerosols and sintering stack of an integrated steelworks, electric steelmaking and glassmaking activities. Despite their low contribution to PM$_2.5$, such industrial sources were the main contributors of metals at the two sites.

226 Estimating the contribution of deposition in the total exposure to PAH’s in order to derive save deposition reference values J. Bierkens, VITO / Sustainable Health; L. Geerts, M. Van Holderbeke, VITO NV; K. De Brouwere, VITO NV / Health; A. Standaert, VITO; C. Cornelas, VITO / Environmental Risk and Health; T. Fierens, VITO Partitioning of PAHs between the particulate and the gaseous phases strongly influences their fate and transport in the atmospheric and human exposure. Dry and wet deposition processes are major sources for PAHs in soil and crops. Our aim was to determine the proportion of the overall burden of environmental and dietary exposure to PAHs that is attributable to deposition in order to derive save deposition reference values. To this end, the fate and human exposure was modelled using the MERLIN-Expo, a software tool that allows to model lifetime exposure, integrating exposure through multiple pathways. Model simulations were based on recent year average concentrations in air and particulate matter (PM$_{10}$) in Belgium. The conceptual model implemented, included inhalation, soil and dust ingestion as well as dietary exposure via the consumption of vegetables, meat and dairy products. Toddlers were chosen as the receptor as they are considered a vulnerable group. Dietary exposure to PAHs via crop consumption was modelled using plant uptake model representing leafy vegetables, fruits and grain, respectively. A cattle model taking its inputs from a grass and maize model was used to calculate concentrations in meat and dairy products. Concentrations in fish were modelled as an external fixed food source. The calculated concentrations for all these food categories were matched to Belgian consumption data in order to calculate dietary exposure. Estimation of the contribution of deposition in the overall exposure was done by comparing a baseline exposure scenario based on recent atmospheric measurement data with a scenario where dry and wet deposition fluxes were arbitrarily set to zero. Save deposition reference values were derived by comparing the calculated overall exposure for the baseline scenario with the oral Tolerable Daily Intake (TDI). It is in case of exceedance, the deposition rates were iteratively adjusted until the calculated exposure equalled the TDI. Simulations were ran for 16 priority EPA - PAHs + benzo[ghi]fluoranthene. For only 4 PAHs sufficient measurement data are available in the EFSA database to perform a realistic check. Of these 4 carcinogenic PAHs, only the calculated exposure to benzo(a)pyrene exceeded the TDI with a factor 3, implying that current deposition rates might be too high. More deposition measurement data for PAHs are required to confirm these results. (The authors thank the Flemish Agency for Health and Care for their support)
of EDCs led to the same conclusions, except in cold season during which the indoor gaseous phase concentrated fewer target EDCs than in summer along with presenting a higher endocrine-disrupting effect, especially estrogenic. In order to identify the bioactive compound families responsible for this endocrine-disrupting potential, a bioassay-directed analysis was developed and may represent an advanced biomonitoring tool for air quality. The gaseous phase was collected in a Parisian home during cold season (winter 2014) and in sufficient quantities (6 consecutive samplings of 15 days) to implement the entire fractionation process by semi-preparative liquid chromatography: split of the original extract into three fractions, each fractionated into three subfractions. All these samples and the multiple controls were submitted to the chemical analysis (68 target EDCs) and the biological analysis (estrogenicity measured by transactivation cellular assay). After applying variables for the quality control of the EDCs in the fractions (concentration level, intrinsic estrogenicity, lipophilicity), major families found indoors (phthalates, synthetic musks, alkylphenols, parabens) stood out as playing a role in the estrogenicity of the gaseous phase, especially the lead compounds butylbenzylphthalate, galaxolide, butyl-paraben and nonylphenol. The data suggest however the involvement of non-studied EDCs in this biological effect. Our data confirm that bioassays represent suitable biomonitoring tools to assess air quality, whether they are associated with the chemical analysis or not.

228 The Modifying Effects of Ambient Air Pollution on Indoor Air Quality, Impacts on Human Health
H. Breuer, B. Buchmeckner, University of Pittsburgh / Civil & Environmental Engineering; W. Collinge, M. Bilec, University of Pittsburgh / Civil and Environmental Engineering
As energy efficient buildings and communities continue to grow, energy retrofits and new designs need to be made in concert with improvements in indoor air quality (IAQ). Although thermal renovations may decrease heat loss and reduce energy expenditures, in improperly designed buildings (tightness) can contribute to infiltration and air exchange rates, and magnify the effects and intensity of internal air pollutants. In this context, a pilot study was conducted to evaluate the human health risk associated with exposure to indoor air pollution in eight buildings ranging from green certified (i.e., LEED Platinum, Living Building) to historic archetypes. The buildings were located in the energy conservation district, which is situated downwind of major industrial point sources. Indoor and ambient measurements of particulate matter (PM	extsubscript{10}, PM	extsubscript{2.5}), black carbon, ozone (O	extsubscript{3}), total volatile organic compounds (TVOC), carbon monoxide, carbon dioxide (CO	extsubscript{2}), relative humidity, and formaldehyde (HCHO) were collected on a seasonal basis. The heterogeneity in ventilation type along with the negative effects of deficient ventilation and aged mechanical systems had on indoor air quality was distinct; however, the counterintuitive findings implied that green and naturally ventilated buildings undergo phenomena similar to conventional buildings within our study. The CO	extsubscript{2} sensors used in most green buildings respond to the number of occupants within a space but does not consider ambient concentrations of criteria air pollutants (i.e., PM	extsubscript{10}, O	extsubscript{3}, NO	extsubscript{2}) before increasing outdoor air volume. Natural ventilation systems were required to apply outdoor air to indoor spaces in the absence of mechanical filtration, and in turn compromise the health and well-being of building occupants. Additionally, green and high-performance buildings are equipped with state-of-the-art HVAC systems that work in tandem with occupancy sensors to optimize energy use when buildings are occupied and minimize energy use when buildings are vacant (or occupied). To this end, with our limited sample size, our results indicated that canopy ventilation and elevated VOCs and HCHO levels overwintered. In this given case, the use of occupancy sensors did not allow proper flush-out of indoor environments and interior finishing prior to the building being opened for operations, and as a result, increases exposure over the lifetime of the building.

229 INNOVATIVE AND LOW-COST MONITORING TECHNIQUES FOR EVALUATING THE SPATIAL VARIABILITY OF PM COMPONENTS: VALIDATION AND FIELD APPLICATION
L. Massimi, Sapienza University of Rome / Environmental Biology; c. perrino, CNR Institute of Atmospheric Pollution Research / Institute of Atmospheric Pollution Research; M. Costabel, Sapienza University of Rome; S. Canepari, Sapienza University of Rome / Chemistry
A new very-low volume sampler has been developed with the purpose of allowing spatially-resolved determination of atmospheric particulate matter (PM) and its chemical components. The low-cost, automatic and self-powered device assures long-term (1-2 months) collection of PM on membrane filters, suitable for subsequent chemical analysis. The device was validated during a study focused on the concentration of PM	extsubscript{10} mass, ionic, levoglucosane, polycyclic aromatic hydrocarbons (PAH) and elements. It showed very good performance in terms of repeatability of the samplings, which is the essential characteristic to build a reliable network. The samplers have been employed, for the first time, to evaluate the spatial variability of PM	extsubscript{10} mass concentration and its main chemical components in the area of Terni, a urban/industrial hot-spot site in an intramountain depression of Central Italy. Lichen transects have been exposed at the same sites of the samplers in order to evaluate the potential of lichens as biomonitors for PM spatially resolved analyses. The meteorological conditions of Terni basin, which limit the dispersion and enhance the accumulation of atmospheric pollutants, are ideal to test and validate new experimental methods for the acquisition of spatially-resolved data.

The added value of using invertebrate species in ecotoxicology: new insights for environmental risk assessment (I)

230 Transgenerational effects of a parental exposure in the sentinel species Gammarus fossarum
P. Cribi, ENTEF, ISTREA LYON; A. Devaux, INRA-CNRS / UMR LEHNA USC INRA IGH ENTEF; K. Abbacci, H. QUEAU, N. Delorme, L. Gamero, ISTREA LYON / UR MALY Laboratoire Ecotoxicologie; S. BONY, INRA - CNRS / UMR LEHNA USC INRA IGH ENTEF; a. chaumont, ISTEA / UR MALY Laboratoire Ecotoxicologie
Since the 80s, the development of molecular biomarkers is an important component of ecotoxicology. Unfortunately, field studies that univocally link biomarker responses to fitness impacts and finally to population level are scarce (1). This is mainly due to the discordance in time scales between toxicological and ecological responses. In previous laboratory studies exploring the effects of high contamination levels of single molecules, a relationship has been established between genotoxic impacts in gametes of the sentinel species Gammarus fossarum, and impairment in embryo production. However, such a link was not observed after exposure to complex mixtures in the field at more environmentally realistic contaminant concentrations (2). Taking advantage of the availability of biomarkers measured in multiple scale in this species, from the molecular level (primary DNA damage, global DNA methylation) to physiological one (feeding rate, molting success, vitellogenesis) and life history traits (growth, fertility, embryonic survival), along with the possibility to conduct rearing culture in the lab (time to puberty about 4 months), the objective of this study was to assess whether biomarker responses recorded in adult gammarids exposed to a chemical stress could be predictive of the fitness of their progeny (i.e. transgenerational effects). For this, the consequences of an exposure in the lab of genitors to environmentally relevant concentrations of cadmium were evaluated in F1 and F2 individuals reared in uncontrolled conditions. In complement, a field exposure experiment through in situ caging of the adult F0 followed by the assessment of the subsequent effects in F1 and F2 progeny currently in progress. References (1) Forbes VE, Calow P, Sibly RM, 2008. The extrapolation problem and how population modeling can help. Environmental Toxicology & Chemistry 27:1987-1994. (2) Lacaze E, Geffard O, Geyot D, Bony S, Devaux A. 2011. Linking genotoxic responses in Gammarus fossarum germ cells with reproduction impairment, using the Comet assay. Environmental Research111:626-634

231 Species differences of bioaccumulation, biotransformation and synergistic effects of two fungicides in two aquatic invertebrates
Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; A. Rösch, Eawag / Environmental Toxicology; D. Fedrizzi, Eawag / Environmental Chemistry; C. Vigueat Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; D. Fedrizzi, Eawag / Environmental Chemistry
Numerous micropollutants have been detected concurrently in aquatic systems, but little is known about the mixture effects of micropollutants in aquatic organisms and the underlying mechanisms. Azole fungicides are known to act synergistically with other chemicals by inhibiting cytochrome P450 (CYP) catalyzed detoxification and thereby enhance the effect of already toxic substances in different organisms. Two widely used fungicide classes co-occur in surface water are strobilurin and azole fungicides. This study aimed to investigate the species' sensitivity to both fungicide classes and to gain mechanistic insights on potential synergistic effects of azoles on strobilurin fungicides in non-target organisms. Therefore, we determined the toxicokinetics of a strobilurin fungicide azoxystrobin and an azole fungicide prochloraz in two aquatic invertebrate species Gammarus pulex and Hyalella azteca. Furthermore, we explored median lethal concentrations (LC	extsubscript{50}) of azoxystrobin in the presence and absence of prochloraz, the inhibition strength (IC	extsubscript{50}) of prochloraz, and its effect on the locomotor behavior of the two species. Bioaccumulation of azoxystrobin were similar in both species with bioaccumulation factors (BAFs) approximately 5 L kg	extsuperscript{-1}, while bioaccumulation of prochloraz was different in two species, with BAFs 57 and 110 L kg	extsuperscript{-1} in G. pulex and H. azteca, respectively. Many biotransformation products were found for azoxystrobin in both species in a combination of urinary and metabolites identified in H. azteca. Most BTPs result from oxidation and conjugation reactions, which occurred at the (E)-methyl β-methoxyacrylate group of azoxystrobin and imidazole ring of prochloraz. Prochloraz inhibited the CYP-catalyzed biotransformation of azoxystrobin in both species, leading to higher internal azoxystrobin concentrations and suggesting synergistic effects. The half maximal inhibition concentration of prochloraz IC	extsubscript{50} in G. pulex was 0.1 and 0.02 μM in G. pulex.
232 Use of Gammarus sp. for toxicity testing. A case study with the growth regulator insecticide fenoxycarb, H. Arambourou, Istrea Lyon / Freshwater system, Ecology and Pollution Research Unit, Istrea / UR MALY Laboratory Ecotoxicology; N. Delorme, K. Abbaci, Istrea Lyon / UR MALY Laboratory Ecotoxicology; P. NOURY, Istrea Lyon / Ecotoxicology; R. Tutundjian, Istrea Lyon / E. Vulliet, Institute of Analytical Sciences; G. Daniele, ISA / Biology; C. Barata, CSIC / Environmental Chemistry; I. Fuertes, Institute of Environmental Assessment and Water Research IDAEA CSIC. V. Debat, MNHN / Institute of Systematics, Evolution and Biodiversity Gammarus sp. (Amphipoda) are widely distributed across European freshwater systems. In the present study, we evaluated the effect of a fenoxycarb exposure on Gammarus sp.. More specifically, i) we assessed the sensitivity of the embryo stage, ii) we identified embryosgenesis’ sensitive period, iii) we evaluated the sensitivity of the reproductive period and iv) we compared the response to fenoxycarb exposure among three Gammarus species. Fenoxycarb is a growth regulator insecticide, analog of the insect juvenile hormone, used for pest management and for veterinary purpose. This study demonstrated that 5 and 50 µg L−1 fenoxycarb can alter embryonic development of G. fossarum. The gastrulation phase was particularly sensitive. Moreover, exposure to 5 and 50 µg L−1 fenoxycarb strongly altered the pre-copulatory behavior in G. fossarum and a 50 µg L−1 exposure prevented the production of viable embryos. These results highlighted the deleterious effects of the insect growth regulator fenoxycarb on gammarid embryosgenesis and reproduction, which could have severe repercussions on population dynamics. The response to the toxic exposure was dependent on the study gammarid species which underlined the importance to consider species with more phylogenetic representation to better assess insect growth regulator effects.

233 Adaptation of Gammarus pulex to agricultural insecticide contamination in streams N. Shahid, Helmholz Centre for Environmental Research UFZ; J.M. Becker, Helmholtz Centre for Environmental Research UFZ / System-Ecotoxicology; M. Krauss, W. Brack, Helmholz Centre for Environmental Research UFZ / Effect-Directed Analysis; M. Liess, UFZ Center for Environmental Research / System-Ecotoxicology Exposure to pesticides affects non-target aquatic communities, with substantial consequences on ecosystem services. Adaptation of exposed populations may reduce the toxic effect of these compounds. However, it is not known under what conditions adaptation occurs when only a low toxic pressure from pesticides is present. Here, we show that Gammarus pulex, a dominant macroinvertebrate species in many agricultural streams, acquires increased tolerance to pesticides when reexposed from non-contaminated recovery area is low. Populations in the field that were exposed to pesticides at concentrations several orders of magnitude below the tolerable threshold showed almost 3-fold higher tolerance to the neonicotinoid insecticide clothianidin (mean EC50 218 ± 11 µg L−1) compared with non-exposed populations (mean EC50 81 ± 11 µg L−1). This tolerance of exposed populations increased from 2- to 4-fold with increasing distance to the next recovery site (0 to 10 km). We conclude that the development of tolerance for non-target species may occur at very low concentrations, much below those affecting sensitive test organisms and also lower than those predicted to be safe by governmental risk assessment frameworks.

234 The use of antifouling bioicides in a changing world: combined impact of nanoengineering and thermal stress in a coral species The use of antifouling biocides in a changing world: combined impact of nanoengineering biocides and thermal stress in a coral species V.L. Ferreira, University of Aveiro / Biology Department and CESAM; M.D. Pavlaki, University of Aveiro / Department of Biology; M. Monteiro, Aveiro University / Biology; F. Maia, Smallmatek – Small Materials and Technologies, Lda.; R. Martins, Department of Biology, University of Aveiro / Department of Biology and CESAM; J. Tedim, University of Aveiro / Department of Materials and Ceramic Engineering; D. Spurgone, A.M. Soares, University of Aveiro / Department of Biology & CESAM; R. Calado, University of Aveiro / CESAM Department of Biology; S. Loureiro, Universidade de Aveiro / Biology The use of antifouling agents to prevent organism’s adhesion onto surfaces continues to be used worldwide. While the European Union already authorized the use of DCOIT (4,5-Dichloro-2-octyl-2H-isothiazol-3-one) biocide, data on its toxicity to non-target organisms is still scarce. Given the advances in the encapsulation of biocides in smart-releasing systems, this work aims to access the impacts of a new antifouling approach, DCOIT encapsulated in silica nanocounters (SiNC@DCOIT), toward the non-target species Saccharomyces cerevisiae, a coral that is also a model of the cnidarian-algae symbiosis found in some marine invertebrates. Elevated seawater temperatures, as predicted by global climate change scenarios, are described as a major cause of corals reef decline. Due to DCOIT photosynthesis inhibition properties, a joint effect of these two stressors (warmer seawater and DCOIT) may occur in the ocean. Toxicity assays were performed by exposing monocoralonal coral fragments (n=5) for seven days, at two different temperatures (present day conditions—26°C—and forecasted scenario for 2100—30.5°C), to 50 µg DCOIT L−1 for free-DCOIT or SiNC@DCOIT and 196 µg SiNC L−1 (nanocontainer control). A negative control was added for each temperature. Photosynthetic parameter (Fv/Fm) was measured using a Pulse Amplitude Modulated Fluorometer (PAM), with the behavioural endpoint (% polypl open) being scored and the biochemical parameters (both in animal and coral) were obtained after 24 h (and the fractions) being determined by mass spectrometry analysis (as catalase (CAT), glutathione-S-transferase (GST) and lipid peroxidation (LPO). Results revealed a decrease on Fv/Fm values at 30.5°C, when compared to 26°C (from 0.65 to 0.60), but only in corals exposed to free-DCOIT the temperature effect was significant throughout the days. By the end of the assay the polyps were mainly open at 26°C, whereas at 30.5°C they were closed. Regarding enzymatic activities, significant increase on the GST of both animal and microalgae fractions was found in 30.5°C groups. On the controls, the rise of 4.5°C in water temperature was responsible for a two or three-fold increase in algae and animal GST activity, respectively. The raise on temperature also induced an increment in CAT activity. Regarding LPO, high variability among samples was found. Overall, under thermal stress, the toxicity of DCOIT is enhanced and the negative impacts associated with the use of this biocide will likely be magnified in the warmer oceans.

235 Assessing interspecific variation in Imdiacloprid toxicity in earthworms A. Robinson1, Centre for Ecology & Hydrology; E. Lahive, Centre for Ecology and Hydrology; S. Short, P. Kille, Cardiff University; D. Spurgone, Centre for Ecology & Hydrology; L. Summerton, Centre for Ecology & Hydrology; M. Robinson1, (alerob@ceh.ac.uk), S. Short1, E. Lahive1, P. Kille, D. Spurgone1 Centre for Ecology and Hydrology, Maclean Building, Benson Lane, Wallingford OX10 8BB, UK 1 School of Biosciences, University of Cardiff, Main Building, Museum Avenue, Cardiff CF10 3AT, UK Widespread interspecific variation is seen in the sensitivity of soil invertebrates to chemical pollution (e.g. pesticides). Since chemical risk assessments are performed on the basis of tests in a small number of reference species there is a danger of significantly underestimating the effect a toxicant may have in the environment. In order to understand these differences a robust and scientifically based ecotoxicological framework for interspecies ecotoxicological extrapolation is needed. In this study a 30 fold difference in the EC50 reproduction values of imidacloprid was observed across 5 species of earthworm (Eisenia fetida, Lumbricus rubellus, Dendrobena octaedra, Apporectodea caliginosa and Amyntas gracilis) with A. gracilis being the most sensitive and L. rubellus the least. The role of toxicokinetics in determining interspecific variations in sensitivity is interpreted by assessing the Accumulation, Distribution, Metabolism, and Excretion (ADME) of the chemical into the body and to the neurological tissues that are the common target using radiolabelled compounds and cold chemistry. The contribution of toxicodynamic traits to variations in sensitivity was assessed through genome analysis to identify 1) the number, nature and activity of key receptor genes present, and 2) molecular docking affinities as affected by the amino acid substitutions present in different species receptor homologues. Finally, to assess how these interactions affect the key biochemical and physiological parameters lead to overt toxicity, we use gene expression, biochemistry and life-cycle measurements. By combining these different approaches and identifying key traits, we seek to improve interspecies extrapolation, better predict species vulnerability, and thereby improved the basis for soil species protection during chemical registration.

Solutions for emerging pollutants - Towards a holistic chemical quality status assessment in European freshwater resources (I)

236 Multiple exposure to pesticides and other emerging pollutants – problems and solutions for healthy ecosystems and humans M. Sante, G. Ungherese, Greenpeace Industrial pollution is a severe threat to water resources around the world, particularly in the Global South factories release hazardous chemicals that impact our precious water resources - causing long term devastation to human health and the environment. Rivers supply vital resources, including drinking water, crop irrigation and food. Therefore it is critical to support system for water quality. In the past decades Greenpeace did several investigations on persistent industrial chemicals like pesticides and industrial chemicals polluting waterbodies. Producing our food within an agricultural system high levels of pollution affects the health of people and the ecosystems. Solutions for emerging pollutants – problems and solutions for healthy ecosystems and humans (I)
The context of Greenpeace's detox campaign has found a wide range of hazardous substances in the waste waters of textile production or in the effluent of communal wastewater treatment plants (WWTPs) from industrial zones in China, as well as in nearby rivers. Case Studies on per- and polyfluorinated chemicals show that PFAS (perfluorinated alkyl substances) are widespread compounds of environmental concern. Because of their well-recognized hazardous properties, long chain PFAS have been subject to increasing regulation. In 2015 Greenpeace carried out extensive work on PFAS in rivers, snow and lake water samples were taken at 10 remote high altitude sites showing that these persistent chemicals are present everywhere on the planet. In 2017 Greenpeace Italy carried out PFAS analyses in wastewaters, analysis revealed PFAS's presence in all tested samples of rivers and drinking water collected in schools and public fountains. It is not too late to act – but now rules and regulations are required. The use of pollution control or wastewater treatment does not deal effectively with all hazardous substances, and only postpones the need for more effective measures. The problem has to be tackled at its source. The Detox campaign challenges top textile brands to work with their suppliers and eliminate PFAS and all other hazardous chemicals across their entire supply chain, and the entire life-cycle of their products. The growing concern about Europe’s massive pesticide use means the goes hand in hand with an increasing need to search for ecological solutions. To be effective, action needs to be based on knowledge, which requires transparency as a first step, the quantities of hazardous substances used and discharged to be reported and monitored, with full availability of data to the public.


237 Benefits of international science & Policy cooperation to promote a paradigm shift in water quality and safety assessment framework

A possible paradigm shift for Water Quality and Safety Assessment Framework / Environment and Health; S. Rinck-Pfeiffer, Global Water Research Coalition; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; F.D. Leusch, Griffith University / Australian Rivers Institute; P.A. Neale, Griffith University / School of Environment; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; M. Dingemans, KWR Watercycle Research Institute; M. Meeker, Water Environment & Reuse Foundation (WE&RF)

Bioanalytical tools hold great promise as an additional tool of our current water monitoring strategies. In vitro bioassays, which are increasingly being applied in water quality assessment, provide relevant and robust predictive biosystems able to specifically and quantitatively measure early adverse effects of contaminants in water, including providing a measure of mixture effect, even in low doses, where included biological components are able to add up the variable along with each other. This allow the provide comprehensive and high-throughput monitoring systems for a wide range of water contaminants, without the use of experimental animals. Smart combinations of chemical & biological analyses can lead to reduced uncertainty in safety assessments, especially with regards to endocrine disruption, oxidative stress as other relevant primary adverse outcome pathways triggered by environmental mixtures of water micropollutants. Gathering the experts worldwide, recent large scale projects delivered several methodological advances leading to a comprehensive framework including the most promising panel of assays and expanded effect-based trigger values (EBT) for both drinking water and environmental waters (GWRC Endocrine Toolbox II, FP7 DEMEAU, FP7 Scacco). The BRAT platform have shown their potential to contribute to strengthen the safety of conventional water treatment plants and be integrated in future regulations. They also could provide robust monitoring frameworks to promote alternative water schemes as promoted by the Blue Print Initiative in Europe to better safeguard water resources and the WHO Potable Reuse Guidance document. While leading players in Australia, Europe and US recommend to incorporate preventive tools to regulatory frameworks, Australia, US (CA), Canada, RIVM, EAWAG, KWR, UFZ, EU-JRC and EU DG-Env, WHO and GWRC, these bioanalytical tools need to be more comprehensively validated and benchmarked across the entire water cycle and against human and ecological health outcomes before they can be adopted in regulatory frameworks. A critical next step will be to derive further EBT for an expanded scope of bioassay endpoints. Several strategies for the derivation of EBT have been proposed but there remains a lack of acceptance and harmonization across the field to allow better acceptance of these innovative water quality and safety frameworks. Covering a wide range of issues including water quality and quantity management and the management of water-related risks, the OECD is endeavouring to capture science as policy recommendations that derive from its past and recent work on water in a single, consistent and action-oriented policy. By hosting a collaborative task-force or expert working group including GWRC experts and gathering international organizations such as WHO, UNESCO and the OECD we can get to benchmark these new effect-based trigger values, and contribute to the water policy by targeting Water effect-based guidelines. Complementary tasks could be to use the by the ESC to Policy interface as a supportive action to better explain and disseminate the associated benefits for stakeholders as citizen towards their health protection, municipalities and local authorities, water professionals and institutional bodies.

238 Chemicals of emerging concern (CEC) in the water cycle – a regulatory perspective

M. Helmecke, Umweltbundesamt (UBA)

Environmental authorities increasingly need to address the challenge of contaminants of emerging concerns found in the water cycle. The German Environment Agency has assessed entry paths, critical load values of chemicals and the existing legislation to derive potential measures to minimize micro-pollutants in the aquatic environment. A holistic and precautionary approach is needed that combines measures at the source, during the usage of products and chemicals as well as end-of-pipe measures. The EU Water Framework Directive and the Marine Strategy Framework Directive pose a legal frame to achieve good status of waterbodies and to cover chemicals far beyond the current 45 “priority pollutants” or even “known” chemicals. Open science and the exchange of information (between for example scientists and regulatory authorities) has a critical role to play in the continuing evolution of NTS. Using a variety of case studies from Europe, this talk will highlight how open science activities such as MassBank.EU (https://massbank.eu), the NORMAN Suspect database (http://www.norman-network.com/?pmode=236) and NORMAN Digital Freezing Platform (http://norman-data.eu) as well as the US EPA CompTox Chemistry Dashboard (https://comptox.epa.gov/dashboard/) can support NTS. Further, it will show how initiatives such as near “real time” monitoring of the River Rhine and retrospective screening via so-called “digital freezing” platforms have opened up new potential for exploring the dynamics and distribution even of as-yet-identified chemicals. Collaborative European and international activities facilitate data exchange amongst analytical data scientists and enable quick, effective and reproducible provisional compound identification in digitally archived HR-MS data. This is leading to new ways of assessing and prioritizing the new generation of “emerging pollutants” in the environment, enabling a pro-active approach to environmental protection that is unthinkable only a few years ago. Note: This abstract does not reflect US EPA policy.

240 Toxicological profiling of water samples with in vitro bioassays and assessment using effect-based trigger values

B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; R. Altenburger, UFZ Centre for Environmental Research / Department Bioanalytical Ecotoxicology; S. Alt-Aissa, Institut National de l'Environnement Industriel et des Risques (INERIS); P.A. Behnisch, Biodetection Systems BV; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; F. Brison, INERIS / Ecotoxicology Unit; S. Buchinger, Federal Institute of Hydrology / Department G Biochemistry Ecotoxicology; W. Busch, Helmholtz Centre for Environmental Research - UFZ GmbH / Biocatalytic Ecotoxicology; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research,
The triazole story: Clarification of sources, fate and footprint in the environment of the molecule 1,2,4-triazole

M. Blank, Bayer AG Crop Science Division / Environmental Safety; B. Harvey, Syngenta; B. Miles, BASF SE / Crop Protection, Environmental Fate Modelling; D. Liss, SGS Institut Fresenius GmbH / Agro

1H-1,2,4-Triazole (124T) is a key structural component of azole-fungicides, one of the world's most widely used fungicide classes in agriculture. The development of crop protection industry taskforce (Triazole Management and Disposal Group, TMDG) is jointly addressing scientific and regulatory topics, covering the environmental fate, metabolism, ecotoxicology, toxicology, and risk assessment of 124T. So far in the regulation of crop protection its origin was interpreted as a result of the breakdown of the parent azole-fungicides only. 124T is toxicologically classified as R63. According to the EU Regulation, Directive 1107/2009, it is a «relevant» metabolite in groundwater and subject to a legal maximum concentration of 0.1 µg/l with respect to crop protection uses. Distinct restrictions on agricultural uses of azole-fungicides have been necessary to meet this hazard based limit value. In response to the large number and widespread use in the EU of registered azole products, regulatory authorities are asking for information about 124T's potential leaching and actual concentrations in groundwater. The TMDG scientists discovered that 124T occurs ubiquitously in the environment, originating also from other anthropogenic sources than azole-fungicides, such as fertilizer additives (to avoid nitrate leaching) and commodity chemicals, and is also naturally formed. To investigate the different sources of 124T and elucidate the pathways of entry and distribution in the environment innovative approaches were needed. The TMDG scientists have therefore expanded their scientific scope into non-agricultural environments and residues in different matrices. The work is supported with a recent terrestrial field dissipation study using a 13C stable isotope labelled azole-fungicide to enable differentiation between the different sources, a forest soil study to assess the background abundance of 124T in non-agricultural soils, and several groundwater monitoring studies. This work has confirmed the wide range of sources of 124T and shown that it is currently not possible to distinguish between their contributions to measured environmental concentrations. Consequently, relying on azole-fungicides as the only source of 124T-concentrations could result in a systematic over-estimation of the environmental exposure risk from pesticide usage. An improved understanding of the sources of the molecule in the environment is a pre-requisite for reliable and justified regulatory conclusions.

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Anthropogenic and natural sources of environmental contaminants highlight the impacts of opposing and conflicting regulations

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The triazole story: Assessment of the background abundance of 1H-1,2,4-triazole in selected German forest soils

M. Blank, Bayer AG Crop Science Division / Environmental Safety; H. Borchers, A. Engel; Bayer Crop Science AG; M. Teltscher, Bayer AG Division CropScience/Environmental Fate / Development Environmental Safety; O. Heimann, Bayer AG Crop Science Division

1H-1,2,4-triazole (124T) is an ubiquitous small molecule which originates from different anthropogenic sources in the environment or from biotic or abiotic degradation of triazole-fungicides. In addition, 124T potentially originates from natural sources like soil microorganisms (Fungi, Actinomycetes). Information about the natural background abundance of 124T in forest top soils of German origin is of importance for the assessment of the entry paths and occurrence levels into the environment by crop protection measures. In a GLP terrestrial field study, duplicate forest top soil samples from ten different locations and different forest types (beech, spruce, pine, oak) in Germany were sampled in 2012/2013 for analytical investigation of the 124T background. For this reason, remote areas without close contacts to agricultural areas were selected. In addition, at two of these ten sites the development of the 124T residue background level was investigated over the period of one year. The background abundance of 124T in the samples ranged from < 1.0 to 1.9 µg/kg in oak forest top soils, from 1.0 to 2.1 µg/kg in pine forest top soils, and from 1.0 to 1.2 µg/kg in spruce forest top soils. In the selected beech forest top soils the background abundance of 124T was below 1.0 µg/kg. The background abundance of 124T in beech and spruce top soil samples taken from April 2012 to February 2013 showed fluctuations over time. These variations could not be associated to seasonal changes. Single values ranged from < 1.0 to 1.8 µg/kg in the beech top soil samples and from < 1.0 to 2.1 µg/kg in the spruce top soil samples. Overall, a background abundance of 124T could be detected in all forest soils, but it is currently not possible to distinguish between anthropogenic 124T sources (e.g. fertilizer additives, metabolites of triazole-fungicides, breakdown product of commodity chemicals) could be excluded. This indicates that the measured 124T residues originate from natural sources in the environment.

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The triazole story: Clarification of sources, fate and footprint in the environment of the molecule 1,2,4-triazole

M. Blank, Bayer AG Crop Science Division / Environmental Safety; B. Harvey, Syngenta; B. Miles, BASF SE / Crop Protection, Environmental Fate Modelling; D. Liss, SGS Institut Fresenius GmbH / Agro

1H-1,2,4-Triazole (124T) is a key structural component of azole-fungicides, one of the world's most widely used fungicide classes in agriculture. The development of crop protection industry taskforce (Triazole Management and Disposal Group, TMDG) is jointly addressing scientific and regulatory topics, covering the environmental fate, metabolism, ecotoxicology, toxicology, and risk assessment of 124T. So far in the regulation of crop protection its origin was interpreted as a result of the breakdown of the parent azole-fungicides only. 124T is toxicologically classified as R63. According to the EU Regulation, Directive 1107/2009, it is a "relevant" metabolite in groundwater and subject to a legal maximum concentration of 0.1 µg/l with respect to crop protection uses. Distinct restrictions on agricultural uses of azole-fungicides have been necessary to meet this hazard based limit value. In response to the large number and widespread use in the EU of registered azole products, regulatory authorities are asking for information about 124T's potential leaching and actual concentrations in groundwater. The TMDG scientists discovered that 124T occurs ubiquitously in the environment, originating also from other anthropogenic sources than azole-fungicides, such as fertilizer additives (to avoid nitrate leaching) and commodity chemicals, and is also naturally formed. To investigate the different sources of 124T and elucidate the pathways of entry and distribution in the environment innovative approaches were needed. The TMDG scientists have therefore expanded their scientific scope into non-agricultural environments and residues in different matrices. The work is supported with a recent terrestrial field dissipation study using a 13C stable isotope labelled azole-fungicide to enable differentiation between the different sources, a forest soil study to assess the background abundance of 124T in non-agricultural soils, and several groundwater monitoring studies. This work has confirmed the wide range of sources of 124T and shown that it is currently not possible to distinguish between their contributions to measured environmental concentrations. Consequently, relying on azole-fungicides as the only source of 124T-concentrations could result in a systematic over-estimation of the environmental exposure risk from pesticide usage. An improved understanding of the sources of the molecule in the environment is a pre-requisite for reliable and justified regulatory conclusions.

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Chemical gene interactions for associating contaminants with biological effects

A. Schroeder, University of Minnesota-Crookston / Math, Science and Technology; D. Martinovic-Weigelt, University of St. Thomas / Biology; G.T. Ankley, D.L. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory

Evaluating the potential human health and ecological risks associated with exposures to complex chemical mixtures in the environment is one of the main challenges of chemical safety assessment and environmental protection. There is a need for approaches capable of integrating chemical monitoring and biological effects data to evaluate chemicals present in the environment. We will present an approach that uses prior knowledge regarding the biological effects of individual contaminants to predict toxicity of mixtures and prioritize contaminants. More specifically, we use chemical-gene interaction networks to develop knowledge assembly models (KAMs; which is specific to the aquatic system of interest) based on chemical monitoring data and publically available chemical-gene interaction data. When only chemical data are available, KAMs allow for the development of site-specific hypotheses for follow-up biological effects testing. When transcriptomics data are available, KAMs can be used with statistical approaches, such as reverse causal reasoning approaches to prioritize risk and contaminants. Two brief examples using chemical-gene interactions and KAMs will be presented. The first example used chemical-monitoring data from the effluent of a local wastewater treatment plant (WWTP) to develop chemical-gene interaction networks. The networks were used to develop hypotheses about the biological effects of the effluent. To test the network predictions, targeted gene expression, using quantitative polymerase chain reaction, was measured from adult male and female fathead minnows that were exposed to the effluent. The second example described a project focused on developing KAM-based chemicals for detecting chemicals at five locations near two WWTPs. Hepatic transcriptomic data from fathead minnows exposed to site-water at each location were mapped to the assembly models to evaluate the likelihood of a chemical contributing to the observed biological responses using richness and concordance statistics. The use of chemical-gene interaction networks and KAMs have strong potential for associating chemical occurrence data to biological effects that, when integrated with adverse outcome pathway knowledge, can guide research and/or monitoring efforts related to the effects of contaminants in the environment. The contents of this abstract neither constitute nor necessarily represent official US EPA views and policies.
Challenges of a groundwater monitoring study design for a substance with multiple sources: determining risk for groundwater from 1,2,4-Triazole formed from fungicides used in arable crops in Germany

B. Harvey, Syngenta; M. Blank, Bayer AG Crop Science Division / Environmental Safety; B. Brumhard, Syngenta Agro GmbH / Registration; P. Edwards, Syngenta Ltd.; A. Kane, Bayer AG Crop Science Division; D. Liss, SGS Institut Fresenius GmbH / Agro; B. Ringsberg, DVGW Technologiezentrum Wasser / Analysis; H. Resseler, Syngenta Agro GmbH; M. Schneider, SGS Institut Fresenius GmbH; H. Staudenmaier, BASF SE / Crop Protection, Environmental Fate

1H-1,2,4-Triazole (124T) is a widely occurring molecule with a number of anthropogenic sources, but also biogenic sources, all of which may result in the presence of the molecule in groundwater. The regulatory framework under which potential risks to environment and health are assessed, including applicable trigger concentrations, depends on the source. As a metabolite of triazole fungicides used in agriculture, 124T is regulated under EU Regulation 1107/2009 and subject to a regulatory trigger concentration of 0.1 µg/L in groundwater. At the same time, 124T is also used in agriculture as a nitrification inhibitor added to mineral fertiliser or slurry, making this a potential additional source contributing to overall soil load. The risk to groundwater from this use is however assessed under other regulations.

To address regulatory concerns about the leaching risk for 124T from combinations of triazole fungicides used in agricultural practise, the industry group TDMG has conducted groundwater monitoring studies in Germany. As the aim was to evaluate the risk from triazole fungicides only, the challenge was to design studies to sample groundwater originating in areas with intensive triazole fungicide usage, where applications of 124T-containing fertiliser and other potential sources could be reasonably ruled out. Existing wells from authorities’ or water producer’s monitoring networks were sampled in the studies, thus capturing a range of scenarios for leaching risk in real-world agricultural practise. To rule out other anthropogenic sources of 124T, for each potential monitoring well a stepwise screening approach was applied to ensure suitability, with in-depth interviews to document relevant product applications and rule out use of 124T-containing fertilizer in the upstream infiltration area. In total 211 groundwater samples from 31 wells in different regions of Germany were analysed. All samples were <0.1 µg/L, with 14 samples between 0.05 (≤LOQ) and 0.08 µg/L. The results show that even with intensive use of triazole fungicides, the concentrations of 124T in shallow groundwater downstream from treated fields did not exceed the regulatory trigger of 0.1 µg/L. The presented approach is considered to be effective to obtain a realistic picture of groundwater exposure to 124T from triazole fungicides in agricultural practise. Ruling out other sources is challenging, but possible with site screening and engagement with the farmers.

247 Overlooked sources of trifluoroacetate in the water cycle - consequences for drinking water supply and regulatory measures

K. Nöderl, TZW DWG-Technologiezentrum Wasser / Analysis and Water Quality department; M. Scheurer, DWG Water Technology Center / Analysis and Water Quality; F. Freeling, DWG Water Technology Center; J. Janda, O. Happel, F. Lange, H. Brauch, DWG Water Technology Center / Analysis and Water Quality

Trifluoroacetate (TFA) occurs as trifluoroacetate (TFA) in the aquatic environment and is considered to be persistent and mobile. Both the acid and its potassium salt are manufactured and/or imported in large amounts in the European Union. Furthermore, TFA is also used as a biocidal degradation product of several pesticides. During a screening of surface waters in south-west Germany, high concentrations of TFA (up to 140 µg/L in a tributary of the River Rhine) were detected. As a consequence, concentrations of TFA at adjacent bank filtration sites and tap waters were also substantially elevated. The here presented study aims on source identification as well as on the assessment of treatment options (ozonation, chlorination, activated carbon filtration) for contaminated raw waters. Ozonation of model substances and wastewater samples was applied to reveal the TFA-forming potential of individual compounds and the presence of not yet identified TFA-precursors in waters bodies in general. Discharge of industrial wastewater was identified as the source of elevated concentrations of TFA in the River tributary. Extended monitoring demonstrated that this contribution still impairs the drinking water supply along the lower River Rhine. Ozonation, activated carbon filtration, and chlorination do not allow for considerable removal of TFA. Monitoring of wastewater treatment plants (WWTP) demonstrated that WWTP also emit TFA. One WWTP showed substantial formation of TFA and ozonation of WWTP-outflows led to increasing concentrations. Tests on the formation of TFA by ozonation of the selected potential precursors demonstrated highly compound-specific TFA-yields between insignificant and ~40%. Sources and pathways of TFA may still hold hidden. As contaminated water resources cannot be efficiently treated by technical options typically applied in water utilities, this topic needs to be addressed for sustainable raw water management. Small molecules such as TFA may originate from different sources and their individual contributions may be subject of temporal and spatial variability. This must be taken into account with regard to risk assessment as well as for the regulation and authorization of chemicals.

Persistence & Biodegradation Assessment

248 Why biodegradable chemicals persist in the environment? A look at bioavailability

L. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiología / Agroquímica y Conservación del Suelo

The biodegradability of a given chemical in the in the environment cannot be assessed properly without considering the chemical’s bioavailability to the degrading microbial populations. This is especially applicable to hydrophobic organic chemicals (HOCs), like polycyclic aromatic hydrocarbons (PAHs). With the aim of providing pathways for implementation into regulatory contexts, this
overview contribution will examine the range of techniques and experimental models suitable for the assessment of HOCs biodegradability taking into account state-of-the-art bioavailability science (Environ. Sci. Technol. 49:10255-10264, 2015). During recent years, we have applied these techniques to study the microbial interconnections with bioavailability processes, involving pollutant phase exchange, microbial mobilization and cell attachment to interfaces. We can consider two groups of techniques: 1) Broadly applied methods to estimate the bioavailable contaminants using Tefen or passive sampling, methods also subject of standardization and 2) specific methods suitable to deeply characterize phase exchange with liquid mixtures and 14C-labelled chemicals. Examples and applications of these approaches will be summarized. They include desorption extraction (Environ. Sci. Technol. 45:3019-3026, 2011; Environ. Sci. Technol. 48:10869-10877, 2014), passive sampling and dosing methods (Environ. Toxicol. Chem. 27:1526-1532, 2008; Environ. Pollut. 184:435-442, 2014; Environ. Pollut. 205:378-384, 2015), constant NAPL/water interfacial area method (Environ. Sci. Technol. 45:1074-1081, 2011; Environ. Sci. Technol. 51:11935–11942, 2017), and radiocresiometry and dual 14Cresiometry analysis (Environ. Pollut. 159:3692-3699, 2011). In spite of these advancements, significant gaps of knowledge exist between bioavailability assessment and biodegradation sciences. Still today, it is difficult to predict bioavailability of HOCs, for example, solely on the basis of basic parameters such as organic matter, black carbon or clay contents of a given soil or sediment, and the physicochemical constants of the chemicals (such as solubility in water, octanol-water or organic-carbon based distribution coefficients). This limitation even remains with improved assessments through determinations of chemical activity and bioaccessibility. This uncertainty not only applies to biodegradability in natural environments, but also to engineered remediation systems.

249 Strategy for ready biodegradability evaluation of poorly water-soluble organic compounds in aqueous media

C. Cheli, T. Vetusky // Research and Innovation; J. Chenhille, L'oreal Research / Research and Innovation; Y. Barthel, Eurofins Expertises Environnementales // Eurofins Expertises Environnementales; J. Lharidon, L'Oréal Research & Innovation / Life Sciences Direction; T. Gerald, University of Nantes / Microbiology

The assessment of the environmental impacts of an environmental substance is based on ready biodegradability tests, demonstrating a rapid biodegradation in most environmental media. However, when these tests are applied to poorly water-soluble substances, difficulties are encountered, often related to their limited bioavailability towards the microorganisms inducing increased variability that we have studied. An innovative strategy has therefore been established in order to improve the assessment of biodegradability of these substances. This study has compared 24 methods of improving bioavailability methods (BIM) and initiated the revision of the international standard ISO 10634.

250 Impact of temperature on micropollutants removal in an activated sludge system

P. Meyang, Newcastle University / CEGS; R.J. Davenport, Newcastle University / School of Engineering; K. Fenner, ETH Zürich/Eawag

The investigation of the environmental fate of pollutants is essential for evaluating their ecological impact and human exposure, and is a priority for the European water framework. In particular, the high variability of micropollutants removal efficiency in biodegradation systems remain a matter of how chemical transport and fate are affected by operational and environmental parameters, such as temperature fluctuations (e.g. daily and seasonal). Currently, environmental exposure assessment uses Arrhenius-based models to estimate biotransformation rates at different temperatures, despite they neglect potential compositional and functional variation of the microbial community. This work aims to evaluate the variability of such models, by exploring the effect of short-term temperature variation on micropollutant biotransformation in an aerobic sludge system. Laboratory batch reactors were seeded with activated sludge from a Swiss full-scale treatment plant and the biotransformation of 93 target micropollutants (6μg/L) was monitored over time at five different temperatures (4–40°C range). The experimental kinetic parameters were compared to model predictions. The microbial population was also characterised by high-throughput sequencing to reveal community composition and activity during the biotransformations. Positive correlation of biotransformation rate constants with temperature was found in the 4–20°C range. At higher temperatures, the biotransformation potential decreased or reached a plateau for the majority of the compounds, and just a limited group showed a steady increase in biotransformation efficiency. A model correctly predict rate constants above 20°C, despite major risk assessment guidelines recommend Arrhenius model predictions in the 0–30°C range. The microbial community also showed significant shift in both composition and activity at higher temperatures, in agreement with the observed decrease in biotransformation potential. Contrarily, for compounds showing an Arrhenius-behaviour over the 4–40°C range, the biotransformation processes may be linked to basic living cell function and not sensitive to temperature fluctuations. Our study highlights limitations in the applicability of Arrhenius-based models for the estimation of chemicals fate in biological systems, and the need to re-examine model parameters to assure more accurate predictions for potential chemical exposure in events of temperature fluctuations.

251 Findings from an international ring test for an improved marine biodegradation screening test

A. Tran, T. Rinfield, Newcastle University / School of Engineering; G. Whale, Shell Health / Risk Science Team; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; B. Roweles, Cefas Lowestoft Laboratory; R. Davenport, Newcastle University / School of Engineering

A series of standardised biodegradation screening tests (BSTs; e.g. OECD 301, 306) have been developed to measure the relative biodegradability of chemicals. Recently, regulatory emphasis has shifted from measuring biodegradation towards prioritisation on chemical persistence. In their current guise, BSTs are ineffective as screens for persistence. They are prone to high levels of variation and produce a large number of fails, many of which can be considered false negatives, wherby a chemical fails a test not because of its recalcitrance, but rather because the test itself has failed. An ECETOC funded workshop to discuss improvements to marine biodegradation testing was delivered in 2015. During this workshop, methodological improvements to BSTs were discussed, in addition to clarifying guidance on testing and interpretation of results obtained from marine BSTs. Methodologically: (i) increasing bacterial cell concentrations to better represent the bacterial diversity inherent in the sampled environments; and (ii) increasing test durations to investigate extended lag phases observed in marine assessments, were recommended to be validated in a multi-institutional ring test. This presentation will report the findings from an international ring test of an improved marine BST, whereby an improved marine BST comprising inocula concentrated by tangential flow filtration, a modified marine BST comprising seawater and a standard OECD 306 closed bottle test were compared across 13 laboratories in the UK, Norway, Germany, Italy, Canada, USA and Japan. Five test chemicals including a positive reference compound (sodium benzoate), a negative reference compound (pentachlorophenol) and three compounds with variable reported degradation (4-nitrophenol, triethanolamine and hydrolysed polycyclalamide), were used to provide a range of biodegradation potentials by which to validate the new method. Biodegradation data for the five chemicals, in the three test systems used, across the 13 participating laboratories will be presented. The need for clearer guidance on biodegradation testing and interpretation will be discussed, with particular reference to test variability and extended lag phases frequently encountered in marine biodegradation assessments. The role which microbial communities play in chemical biodegradation and the extent to which microbial community analysis can explain inter– and intra-laboratory variation in biodegradation test outcome will also be discussed.

252 Relevance of photolysis for the fate of pendimethalin in deeper water layers - results of a scale-up approach according to OECD TG 309

D. Hennecce, Fraunhofer IFRF - Institute for Molecular Biology and Applied Ecology / Ecological chemistry; M. Kruse, Fraunhofer IFRF - Institute for Molecular Biology and Applied Ecology; J. Hassink, BASF SE / Environmental Fate. OECD TG 309 “Aerobic Mineralisation in Surface Water” is currently used under different regulatory frameworks for the persistence assessment of chemicals in surface water. The test is performed in batch to measure biodegradation at defined conditions. Other processes which might be relevant for the fate of a chemical in the aquatic environment are direct photolysis, indirect photolysis, hydrolysis and water exchange with liquid mixtures and particulate matter. In the case of pendimethalin, which is known as a photolysis unstable compound (4-nitrophenol, triethanolamine and hydrolysed polycyclalamide), were used to provide a range of biodegradation potentials by which to validate the new method. Biodegradation data for the five chemicals, in the three test systems used, across the 13 participating laboratories will be presented. The need for clearer guidance on biodegradation testing and interpretation will be discussed, with particular reference to test variability and extended lag phases frequently encountered in marine biodegradation assessments. The role which microbial communities play in chemical biodegradation and the extent to which microbial community analysis can explain inter– and intra-laboratory variation in biodegradation test outcome will also be discussed.

253 Poster spotlight: TU267, TU268, TU269
Integrating life cycle approaches towards a sustainable circular economy (I)

254 How can we measure a sustainable circular economy? Unveiling current indicators for the life cycle of products
H. Helander, A. Petit-Boix, S. Leipold, University of Freiburg / Chair of Societal Transition and Circular Economy

Currently, EU policy on circular economy (CE) aims to decrease environmental damage as well as secure the future supply of resources to support economic growth. Even though the implementation of new strategies might cause burden shifting, it is mostly assumed that an increased circularity of resources results in environmental benefits. At the same time, indicators suggested to assess CE progress often fail to provide an assessment of both CE goals and strategies from a sustainability perspective. A life cycle perspective provides a point of departure to address CE strategies, as the stages involved in the circulation of materials are clearly illustrated. Nevertheless, which indicators to assess is still to be defined to support the implementation of CE at any stage of the supply chain. This contribution aims to identify the type of indicators suggested to measure the progress towards a CE at a product level and to evaluate these in relation to the overarching goals and the implementation strategies of CE. To this end, we first define the main CE goals and implementation strategies identified in recent literature and translate these into measurable flows by creating a system model that accounts for each step in the product life cycle. Finally, we review the literature on CE indicators and classify them into CE goals and strategies, life cycle stages and flows addressed, and measurement units (i.e. economic, mass, energy or environmental impact). This contribution provides a consistent framework to compare and assess CE performance indicators at a product level. It also aims to develop decision-making analysis for defining and assessing CE through a structural assessment of currently suggested CE performance indicators, we can define gaps and needs in the monitoring process of CE to ensure that progress contributes to the overarching goals of CE and in turn capture trade-offs between implementation strategies.

255 Making sense of circularity indicators with Multi Criteria Decision Analysis
M. Niero, Aalborg University / Department of Chemical and Biochemical Engineering & Department of Management Engineering; P. Kalbar, Indian Institute of Technology Bombay / Centre for Urban Science and Engineering (CUSE)

The focus of this study is on packaging, i.e. a sector with high priority for circular economy (CE) implementation, by exploring a situation where a company intends to compare the circularity performances of different products in order to identify which is the best option from a CE perspective. We considered six different packaging alternatives for beer in different contexts and calculated the following indicators to assess product-level circularity: i) the Material Reutilization Score (MRS), included in the Cradle to Cradle® certification program; ii) the Material Circularity Indicator (MCI) developed by the Ellen MacArthur Foundation and Granta and iii) the most relevant impact categories according to the Product Environmental Footprint Category Rules for beer product category, i.e. climate change (CC), acidification (Ac), and marine eutrophication (ME). The Multi Criteria Decision Analysis (MCDA) is a useful tool for this purpose. Through an integration approach to aggregate indicators representing performance of the product system with respect to various aspects such as material recyclability, recycled content and eco-efficiency. We argue that ranking the alternatives based on such approach will ease the identification of the best packaging alternative from a CE perspective. The MCDAs is applied to process the indicator scores and subsequently obtain the ranking. Specifically, the compensatory approach based on the MCDA method TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) is used for ranking the six alternatives. The results of the stand-alone application of the two types of indicator sets, i.e. those focusing only on circularity (MRS and MCI) and on life cycle assessment (CC, Ac, ME) is different. The ranking of the packaging is the same within the life cycle assessment indicators, but differs when MCI and MRS are considered. The implementation of the MCDAs with different weighting sets shows that two alternatives are dominating i.e. have higher scores for all the indicators. These two alternatives are ranked in the first two positions in all the weighting schemes and hence the ranking is considered as stable. The use of MCDA in combination with several product-circularity indicators is thus recommended to support companies in the identification of the best alternative from a CE perspective.

256 Consistent allocation using archetypes of LCA Goal and Scope definitions
D. Schrijvers, ISM; G. Sonnenmann, University of Bordeaux / ISM CyVi

Identifying a suitable allocation procedure is always a challenge in the modelling of life cycle assessment (LCA). This fundamental question often comes up when assessing products and that could be used in multiple life cycles due to efficient recycling. PE International recommend how to apply allocation for the production and recycling of metals [1]. However, by recommending both partitioning and substitution for establishing the data for an attributional LCA, several inconsistencies are introduced. It becomes unclear to what research question LCA results respond if different modelling approaches are combined in a single LCA study. We developed archetypes of LCA Goal and Scope definitions – in the form of research questions – that aid in identifying a suitable and consistent allocation procedure. In order to identify which LCA study simulations the fundamental question of the LCA goal and scope need to be clearly defined: the topic of the LCA, the perspective, the reason to conduct the study, and potential additional functions of the product system that are taken into consideration. We present a framework that shows how the allocation procedure is dependent on the different LCA approaches that are defined in the goal and scope of the LCA. Based on this framework, building blocks are devised that are used to formulate research questions. These research questions represent archetypes of goal and scope definitions. The presented framework shows that there is a relevant difference between system expansion and substitution, and that we must differentiate between process-oriented and product-oriented LCAs, which is not common practice. Furthermore, we show that all types of LCA approaches can be used to support decision-making, which is often only ascribed to consequential LCAs. It is concluded that it is not the topic but the research question of the LCA study that determines the most suitable allocation procedure. One LCA topic (e.g. 1 kg of recycled aluminium) can already be used for at least 13 different research questions. “What is the impact of 1 kg of recycled aluminium?” is not detailed enough to identify an LCA modelling approach. This paper shows the level of detail that is required to enable this. The importance of a research question is not always as evident as the production phase of the laptop is modified to reflect a closed loop for recovered materials. Based on data collected by a reuse organisation, computers are often considered for self-repair by consumers. In order to increase the number of successful repairs and reduce the required time, current European policy aims to improve the reparability of products. The potential environmental benefits of reuse after repair is investigated by considering a baseline, recycling and reuse scenario. The baseline scenario is considered to be the worst case because it does not consider any recycling or reuse and it assumes all waste is incinerated. A professional use of 3 years is assumed with an annual electricity usage of 76 kWh from the average European grid. For disposal, a specific incineration dataset was calculated based on the assumed laptop composition using the available ecoinvent waste tools. In the recycling scenario the laptops are collected and sent to a recycling plant for material recovery. Reuse scenarios are divided into three categories: i) the most relevant impact categories according to the Product Environmental Footprint Category Rules for beer product category, i.e. climate change (CC), acidification (Ac), and marine eutrophication (ME). The Multi Criteria Decision Analysis (MCDA) is a useful tool for this purpose. Through an integration approach to aggregate indicators representing performance of the product system with respect to various aspects such as material recyclability, recycled content and eco-efficiency. We argue that ranking the alternatives based on such approach will ease the identification of the best packaging alternative from a CE perspective. The MCDAs is applied to process the indicator scores and subsequently obtain the ranking. Specifically, the compensatory approach based on the MCDA method TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) is used for ranking the six alternatives. The results of the stand-alone application of the two types of indicator sets, i.e. those focusing only on circularity (MRS and MCI) and on life cycle assessment (CC, Ac, ME) is different. The ranking of the packaging is the same within the life cycle assessment indicators, but differs when MCI and MRS are considered. The implementation of the MCDAs with different weighting sets shows that two alternatives are dominating i.e. have higher scores for all the indicators. These two alternatives are ranked in the first two positions in all the weighting schemes and hence the ranking is considered as stable. The use of MCDA in combination with several product-circularity indicators is thus recommended to support companies in the identification of the best alternative from a CE perspective.

257 Sustainability assessment of product lifetime extension through increased repair and reuse
E. Bracqueme, J. Peeters, J. Duflo, KU Leuven / Department of Mechanical Engineering; W. Dewulf, KU Leuven Association/Group T / Department of Mechanical Engineering

The concept of circular economy is characterized by an economy that aims to keep products, components and materials at their highest utility and value at all times. Based on data collected by a reuse organisation, computers are often considered for self-repair by consumers. In order to increase the number of successful repairs and reduce the required time, current European policy aims to improve the reparability of products. The potential environmental benefits of reuse after repair is investigated by considering a baseline, recycling and reuse scenario. The baseline scenario is considered to be the worst case because it does not consider any recycling or reuse and it assumes all waste is incinerated. A professional use of 3 years is assumed with an annual electricity usage of 76 kWh from the average European grid. For disposal, a specific incineration dataset was calculated based on the assumed laptop composition using the available ecoinvent waste tools. In the recycling scenario the laptops are collected and sent to a recycling plant for material recovery. Reuse scenarios are divided into three categories: i) the Material Reutilization Score (MRS), included in the Cradle to Cradle® certification program; ii) the Material Circularity Indicator (MCI) developed by the Ellen Mac Arthur Foundation and Granta and iii) the most relevant impact categories according to the Product Environmental Footprint Category Rules for beer product category, i.e. climate change (CC), acidification (Ac), and marine eutrophication (ME). The Multi Criteria Decision Analysis (MCDA) is a useful tool for this purpose. Through an integration approach to aggregate indicators representing performance of the product system with respect to various aspects such as material recyclability, recycled content and eco-efficiency. We argue that ranking the alternatives based on such approach will ease the identification of the best packaging alternative from a CE perspective. The MCDAs is applied to process the indicator scores and subsequently obtain the ranking. Specifically, the compensatory approach based on the MCDA method TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) is used for ranking the six alternatives. The results of the stand-alone application of the two types of indicator sets, i.e. those focusing only on circularity (MRS and MCI) and on life cycle assessment (CC, Ac, ME) is different. The ranking of the packaging is the same within the life cycle assessment indicators, but differs when MCI and MRS are considered. The implementation of the MCDAs with different weighting sets shows that two alternatives are dominating i.e. have higher scores for all the indicators. These two alternatives are ranked in the first two positions in all the weighting schemes and hence the ranking is considered as stable. The use of MCDA in combination with several product-circularity indicators is thus recommended to support companies in the identification of the best alternative from a CE perspective.
where they can benefit from different residual flows that were previously being wasted. In ICTA-ICP building (4 floors), in the UAB campus (Bellaterra, Barcelona), a rainwater harvesting system stores rainwater on an underground tank, from which water is pumped to the rooftop to irrigate the crops with a hydroponic automated system. In the third floor, high CO₂ concentrations (up to 820ppm) and more stabilized temperatures (between 15 and 22°C) are reached. The transport of the air to the rooftop could benefit crop production by performing a CO₂ enrichment and providing more suitable temperatures to the plants. In this aspect, an open chamber made of steel and LDPE will be used to compare its environmental performance and production with a control crop, using life cycle tools. In this direction, previous LCA studies have stated that the fertilizers are one of the items that exerts the greatest impacts in i-RTG systems. Hence, different nutrients are being optimized. In this sense, different literature expresses that half of the currently economically phosphate resources will have been used up in 50 to 100 years. To optimize P cycle, struvite has been defined as a potential source of this nutrient. With a circular economy perspective, wastewater treatment plant precipitated struvite will be used as the P source for crops in the i-RTG in two different ways: mixing struvite in the nutrient solution and by adding struvite in perlite sacks (hydroponic substrate). The goal of this contribution is thus to evaluate the CO₂ and P cycles in an i-RTG through experimental and environmental studies by considering circular economy strategies. With these enhancements, urban agriculture will cut its environmental impacts, making it a more sustainable source of food for cities.

259 Chemical recycling of plastic packaging waste - A life cycle perspective on PET recycling R. Meyn, RWTH Aachen University / Chair of Technical Thermodynamics; S. Westhues, RWTH Aachen University; J. Klanckemayer, RWTH Aachen University / Institute for Technical and Macromolecular Chemistry; A. Bardow, RWTH Aachen University

Plastic packaging waste is one of the priority areas inside the European action plan for the transition to a circular economy. To establish a circular economy, a potential large-scale avenue is chemical recycling of plastic packaging waste. However, preliminary assessments of chemical recycling technologies rate them inferior compared to mechanical recycling not only from an economic but also from an environmental point of view. In based on these results, we develop a method based on life cycle assessment to evaluate the environmental performance of chemical recycling to produce chemicals. The method calculates the maximal environmental impact reduction for chemical recycling technologies for future industry setups. To calculate the maximal environmental reduction, a general model of the life cycle of plastic packaging waste is developed from cradle-to-grave. The results are benchmarked against both mechanical recycling and energy recovery for the environmental impact categories climate change and fossil resource depletion. The basis of the calculations are four key system parameters: (i) the efficiency of the waste treatment technology and the environmental impacts of (ii) production of secondary materials, (iii) the waste treatment technology and (iv) the target chemical produced by chemical recycling. In this paper, we present the methodology used to evaluate chemical recycling technologies for polyethylene terephthalate (PET). In this case study, we show how to need to produce high value-added chemicals from chemical recycling technologies to possibly achieve an environmental benefit compared to mechanical recycling. To improve on mechanical recycling, chemical recycling needs to yield a chemical that is currently produced with an impact on climate change or fossil resource depletion exceeding 2.54 kg CO₂ eq. or 1.58 oil-equ. per kg, respectively. To the best of the authors’ knowledge, no chemical in patents or literature meets both of these threshold values. In contrast, chemical recycling is beneficial compared to energy recovery in all studied cases. The presented method enables the easy and early-stage assessment of the maximal environmental reduction of chemical recycling. The case study shows that chemical recycling should target PET waste that is currently used for energy recovery or needs to transform waste from mechanical recycling to high-value-added chemicals.

Informed substitution of hazardous chemicals for circular economy: science and practice


In 2009 PFOS, its salts and PFOSF were added to the UNEP Stockholm Convention aiming at protecting human health and the environment from POPs. However, the addition contained twenty exempted uses, for which PFOS could still be produced and used. These exemptions were accepted, accompanied by a decision to evaluate uses at regular intervals in order to facilitate a total phase out. Besides the evaluation, the Convention provides Guidance of alternatives to PFOS, which is regularly updated and meant to facilitate the Parties to the Convention in phasing out PFOS. The evaluation was carried out in 2014 under the POPs Review Committee. In 2016 the previous Guidance on alternatives was updated, followed by endorsement in 2017. The update focused on all known applications of PFOS, including the twenty exemptions. However, priority was given to the open applications in two pesticide uses, namely insecticidal sprays for control of leaf-cutting ants from Atta spp. and Acromyrmex spp. and insecticides for control of red imported fire ants and termites. Data on the persistence and degradation of PFOS and the potential substitutes were presented. The guidance will focus on the further need of PFOS and the specific uses in various Parties under the convention and possible alternatives among which chemical and non-chemical ones. The recommendations of the POPs Review Committee led to the decision to request the Parties using PFOS for ant bait to deliver data on production and use and monitoring data on emissions at the point of use. In conclusion, that in phasing out a substance, it is necessary to understand the functional characteristics of the substance in that specific application and to follow a case by case approach. This enables to find alternatives and to define the proper measures. A multidisciplinary approach is indispensable in this phase-out process.

261 Experiences of "Substitution in Practice" C. Jonsson, Swerea IVF AB / Energy and Environment; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); I. Cousins, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); I. Veen, Institute for Environmental Studies (IVM) / University of Amsterdam

Within the research project SUPPES (Substitution of Per Fluorinated Compounds to Eliminate Diffuse Sources), research on the substitution of hazardous chemicals in consumer products is focused on identifying feasible solutions with better sustainability performance. Such substitution model, suggesting evaluation for both technical as well as environmental and health performance, requires an interdisciplinary approach to create and/or identify feasible alternative solutions. The SUPPES project has demonstrated an iterative model for practical substitution where in addition to evaluating the environmental and health performance of alternatives, the technical and economical performance are also included. It is clear that distinct substitution strategies will be required for PFASs in different textile products because of the range of performance requirements. Evaluating functionality of the different products revealed that it is critical to have a chemical (alternative) product that has the required functionality, but also to measure function in new ways matching the actual requirements. Hazard assessment is required to cover all environmental and health effects. In addition to regulatory requirements, toxics (e.g. PFASs) that are toxic to humans (e.g. PFASs) that are toxic to humans are known to be released in the environment and may also have negative effects on humans. Variations in the functional properties of chemicals are required to be considered in an environmental assessment.

262 Implementing a life cycle perspective in chemical alternatives assessment - the case of per- and polyfluoroalkyl substances in textile applications H. Holmelund, Chalmers University of Technology; S. Roos, Swerea IVF AB / Energy and Environment; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); C. Jonsson, Swerea IVF AB / Energy and Environment; G.M. Peters, Chalmers University of Technology / Department of Chemistry and Chemical Engineering

Informed chemical substitution is about eliminating chemicals that give rise to unacceptable (eco)toxicological risks, while avoiding problem shifting within a product’s or chemical’s life cycle, or between types of impacts. For this reason, the life cycle perspective becomes crucial. Chemical alternatives assessment (CAA) performance has been increasingly in focus in the last years, and life cycle assessment (LCA) and environmental impact categories migth give contradictionary decsion support. However, more detailed guidance is lacking and few practical examples have been published. A substitution case of current relevance is the phase-out of hazardous per- and polyfluoroalkyl substances (PFAS) from durable water repellent (DWR) textile applications. Alternatives are sought which offer sustained technical performance but an improved environmental and human health profile compared to the hazardous PFAS. To support an informed substitution of hazardous PFAS, and complement our previous hazard assessment, we have conducted an LCA to compare environmental and human health impacts across DWR alternatives on a
263 How much function do we need in textiles? Strategies for replacing PFASs based on end-user requirements

S. Schellenberg, Stockholm University / Department of Applied Environmental Science (ITM); P. Hill, University of Leeds / School of Design; O. Lenzstern, University of Börs; P. Gillgard, Swerea IVF AB; R. Blackburn, P. Goswami, M. Taylor, University of Leeds; I. Cousins, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES)

Current approaches to substitute harmful chemicals could benefit from a broader perspective when it comes to the functionality they provide in consumer products. Following the concept of “functional substitution,” this study presents an evaluation of material properties of new durable water repellents (DWR) for textiles focusing on end-user requirements. Since the phase out of side-chain fluorinated polymers (SFPs) based on long perfluoroalkyl moieties that were associated with the release of persistent, biaccumulative and toxic perfluoroalkyl acids (PFACAs), a variety of new DWRs have been developed including biodegradable materials that are based on renewable resources. To consider their unique properties to provide substance positions for hydro and oleophobic fibre modifications SFPs based on long perfluoroalkyl chains were historically used on all kinds of different textiles applications. It is so far unclear if alternative DWRs can follow this “one solution will solve all” approach. By segmenting the textile sectors in terms of liquid repellency, this study sets out to identify the different requirements of end users for functional outdoor clothing and occupational medical apparel. For functional outdoor clothing, a “bottom-up” strategy was chosen by using a survey to assess the consumers’ needs and expectations. For occupational medical apparel, exposure scenarios to liquids were defined based on protection needs described by the Center for Disease Control and Prevention (CDC). Based on these demands, relevant liquids were chosen to evaluate repellency. The provided Case study is based on using established material test methods and by developing a new method to determine the roll-off angle for textiles. It has been found that some non-fluorinated DWRs based on green chemistry concepts showed excellent water repellence and also a resistance towards the penetration of liquids with intermediate polarity (e.g. orange juice and synthetic blood). When it comes to liquids with very low surface tension like gastric fluid evaporation, low surface repellency, but the only materials that protected against liquid penetration. This study of chemical substitution based on chemical and textile functionality as well as end-user requirements pointed out the opportunities and limitations for functional substitution.

264 Analysis of the technical and economic feasibility of alternatives to lead gunshot

A. Mazzolini, D. Mottet, P. Simpson, C. Loghtmejer, C. Rheinerberger, M. Blainey, ECHA / Risk Management Implementation Unit

An analysis of the technical and economic feasibility of alternatives to lead gunshot has been prepared by ECHA as part of a REACH Annex XV Restriction Report on lead and lead compounds used in shot in wetlands. Lead has historically been used in cartridges because of its softness, low melting point, high density, relatively low price and high abundance. Because of these properties, lead is often considered to be the ideal material for use in ammunition. Steel gunshot (soft iron) is by far the most well-devised: other metals include bismuth and tungsten. The alternatives have a somewhat different ballistic behaviour, but they are still technically and economically suitable alternatives to lead gunshot. However, some adaptation is required by the shooter to use alternatives successfully, including the following: Adaptation of the shot size used as this would typically need to be increased to counter for the lower density of steel. Awareness that shotguns are a range weapon and influenced by wind and weather. Safety in terms of ammunition performance, if fired at targets within a range of 35m Training should be done using shot of the same material as is intended for use in hunting/shooting. This suggests that, in assessing hunting/shooting success, the individual skills of a shooter are more decisive than the type of ammunition used. The fact that several countries in the EU have implemented a full ban on the use of lead shot (for example Denmark and Netherlands) is evidence that alternative gunshot is suitable for both hunting activities and sports shooting. Steel shot is the most common alternative to lead gunshot due to its similar price per cartridge, making it the cheapest of the currently available alternatives. Some hunters may need to modify an existing shotgun to enable the use of steel gunshot. However, major gun manufacturers have confirmed that the vast majority of modern shotguns can fire alternative shot materials without any problem. In rare cases, a very old shotgun may need to be replaced or the hunter needs to use the more expensive bismuth or tungsten shot. The analysis of alternatives indicates that the use of alternatives to lead gunshot for hunting and shooting in wetlands is technically and economically feasible. While the availability of such alternative gunshot may currently vary across the EU Member States, it can be expected that a rise in demand triggered by an EU-wide regulatory action will be met on the supply side.

265 The road to successful substitution: case studies

N. Vallotton, N. Ball, Dow Europe GmbH / Toxicology Environmental Research and Consulting; H.M. Hollnagel, Dow Europe GmbH / Toxicology and Environmental Research and Consulting

Delivering innovative products and solutions to the market is a driver for research and development. Drivers of innovation include changes in the market demand or the availability of new technology. New substances or new products are continuously being evaluated for their performance, functionality and safety in a given application. Adaptation to the market demand thus often leads to substitution in the use of one substance for another providing improved functionality. Beyond the evaluation of the product’s safety throughout its life-cycle, increased regulatory pressure such as possible changes in hazard classification plays a role in the selection of alternative candidate substances. In a limited number of cases, the evaluation of alternatives is required by regulatory frameworks, such as the authorisation process under the REACH regulation. However, substances of very high concern (SVHC) are identified solely based on their hazard profile (e.g. CMR or PBT properties), and do not consider findings from the overall safety assessment which includes an assessment of risk. Substitution driven by the hazard characterisation alone raises a number of questions in the search for alternative substances. Relevant candidates need to demonstrate equivalent or enhanced performance and functionality in the same range of applications and demonstrate a superior environmental and health profile based on their hazard properties. However, there is a concern that substitutions based on hazard criteria may lead to regrettable substitutions, for example when it is unclear if a substitution presents a benefit in terms of overall risk to human health and the environment. Comparative risk assessment may prove to be complex as the substances typically do not have the same level of testing information to characterise the hazard. In addition, exposure may occur at greater levels when the uses require higher use rates or if processing and handling lead to higher exposures. Finally, identifying a candidate substance providing a broad range of functionalities allowing substitution in all given application is a challenging Case study. This paper aims to demonstrate the challenges faced by R&D scientists and the need to work closely with experts in disciplines as varied as chemistry, chemical engineering, EH&S specialist and application specialists during the long search for candidate substances having to meet value chain requirements in terms of performance and EH&S profile.

Big data analysis in ecotoxicology: how to get new information out of existing data?

266 EDAPHOBASE - soil biodiversity data warehouse and its applications in ecotoxicology

M. Ross-Nickoll, RWTW Aachen University, Institute for Environmental Research / Institute for Environmental Research; U. Burkhardt, Senckenberg Museum of Natural History Görlitz; J. Hausen, RWTW Aachen University Institute for Environmental Research, Aachen; H. Höfer, Staatliches Museum für Naturkunde Karlsruhe; S. Jansch, ECT Oekotoxikologie GmbH; S. Lesch, Senckenberg Museum of Natural History (SMNH), Görlitz; J. Oellers, gaiac  Research Institute for Ecosystem Analysis and Assessment, Aachen; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research; F. Raub, State Museum for Natural History (SMNK), Karlsruhe; S. Rick, Senckenberg Museum of Natural History (SMNH), Görlitz; J. Rönbke, ECT Oekotoxikologie GmbH; B. Scholz-Starke, RWTW Aachen University, Institute for Environmental Research / Institute for Environmental Research, Aachen; R. Oellers, gaiac Research Institute gaiac; D.J. Russell, Senckenberg Museum of Natural History, Görlitz

In this talk we present the soil-zoological information System EDAPHOBASE, a taxonomic-ecological database system, developed within a joined research project funded by the German Federal Ministry of Education and Research (BMBF). It combines existing taxonomical primary data on soil organisms from collections, scientific literature and reports in a data warehouse. Up to now EDAPHOBASE contains more than 500000 observations, about 300000 sites, an 140000 taxa. Data can easily be imported, quality checked, published, queried and analyzed via a web application interface. Detailed analyses can be performed with the interactive web application EDAPHOSTAT which allows species-level analysis as well as definition of reference communities. Future development of EDAPHOBASE towards a pan-European soil biodiversity data warehouse is focussed on (1) the development of a harmonized tool for the evaluation of ecological soil quality, (2) the collection and usage of existing data from different parties all over
Europe, (3) the provision of a reference base of the ecological quality of soils and (4) the coverage of relevant needs of as many as possible European policies. Finally, necessities for practical use in common agricultural policy, circular economy and for EU transboundary issues are discussed.

267 Diving into REACH database with Rstudio to produce input data for the USEtox model for thousands of chemicals


In the context of the EU commission product environmental footprint activities (PEF) [1,2], the potential impact of chemicals emitted during the life cycle of a product is assessed via the USEtox multimedia fate model [3]. For each single chemical, this model requires dozens of physico-chemical parameters as well as data on ecotoxicity to freshwater aquatic life and toxicity to human for cancer and non-cancer endpoints. For PEF those data are required for thousands of chemicals, using the most up-to-date information [4,5]. The EU commission Joint Research Centre has obtained from the European Chemicals Agency (ECHA) data on more than eight thousand chemicals. These data includes all the physico-chemical properties (166’926 test results), ecotoxicity (305068 test results) and human toxicity data (41’381 test results) available in the IUCLID 5.5 database (as of May 2020). Data of the Brine shrimp, Ceriodaphnia, Daphnia magna are unique values for chemical properties and toxicity indicators for thousands of chemicals. The present paper focuses on the use of REACH data to calculate chemical Effect Factors. All the REACH registration data on physico-chemical, aquatic ecotoxicity and human toxicity were exported from the IUCLID 5.5 database into individual Excel files. Each Excel file was imported into the R-studio program [6] where data treatments / manipulations / calculations were performed. R allowed us to build code in step wise manner until we obtained the desired selection without impacting the structure of the original file (Excel). The final code can be released to the scientific community to be reapplied on the original files obtained from the REACH database. The ecotoxicity data extracted from the IUCLID database contained about 7500 substances covering almost mono and multi-constituents as well as UVCB (Unknown or Variable composition, Complex reaction products or Biological materials). The database covers acute and chronic toxicity tests for various organisms with about 305’068 End-point study reports (ESR)

268 The effect of modelling decisions on macroinvertebrate sensitivity modelling

S.v. Berg, Wageningen University & Research / Aquatic Ecology and Water Quality Management; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; C. Rendal, Unilever / Safety and Environmental Assurance Centre SEAC; E. Butler, Unilever; F. De Laender, Université de Namur ASNBL / Research Unit in Environmental and Evolutionary Ecology and Aquatic Wageningen UR / Aquatic Ecology and Water Quality Management Group b Alterra.

Main challenges in modern ecological risk assessment (ERA) lie in the simultaneous occurrence of species diversity and compound multiplicity. The recent development of trait-based sensitivity models has proven to be successful in tackling this problem. However, this methodology is one of the first of its kind, and has remained a work in progress. This paper aims to critically evaluate the available methods in a critical manner. We start by implementing the original method, which will be used as the null model when comparing the different modelling alternatives. As input data, a toxicity, chemical classification, chemical characteristics, and a traits database are used. First, the relative sensitivity of each species to each compound is calculated. Next this relative sensitivity is averaged over all compounds belonging to the same Mode Of Action (MOA) class, resulting in a Mode Specific Sensitivity (MSS) value. Subsequently, exhaustive multiple linear regressions are made between MSS values and species traits, looking for traits which are best in explaining species sensitivity. The next step is to see the effect of different modelling decisions. As a first aspect, the effect of the used model selection criterion is studied. This is done by comparing the cross-validation error resulting from using the adjusted R² or the Akaike Information Criterion (AIC). As a second aspect, the effect of the used taxonomic level during species-trait matching is studied by comparing the adjusted R² of models resulting from species-trait matching done at family or at genus level. Third, two methods for exploiting species traits data are explored, trying to find out whether using the individual traits were recommended. R allowed us to build code in step wise manner until we obtained the desired selection without impacting the structure of the original file (Excel). The final code can be released to the scientific community to be reapplied on the original files obtained from the REACH database. The ecotoxicity data extracted from the IUCLID database contained about 7500 substances covering almost mono and multi-constituents as well as UVCB (Unknown or Variable composition, Complex reaction products or Biological materials). The database covers acute and chronic toxicity tests for various organisms with about 305’068 End-point study reports (ESR)

269 New approach facing new challenges in Ecotoxicology: D counter

S. Abreu, University of Aveiro / Dep. Biology & CESAM; A.M. Soares, University of Aveiro / department of Biology & CESAM; R.E. Martins, M. Oliveira e Silva, University of Aveiro / DETI IEETA

Routine tests in Ecotoxicology are simple, relatively inexpensive and rapid methods. They can be used to compare the sensitivity of various bioassays to chemical pollutants but data are globally missing for marine organisms. In addition, studies have mainly been focused on only one species under the same exposure, but toxicity exposure involving several species are scarce. D counter is an innovative device that can be used in ecotoxicology assays involving not only one, but also two or more different species, and proving separated data from each of the species coexisting under simultaneous exposure, whenever chromatic differentiation can be achieved among the species. D counter has been mainly pointed to organisms with body sizes from 0.2mm to 3mm, but it also has been tested with larger organisms, and it can be applied either to freshwater, estuarine or marine species, being suitable in bioassays using for example, the brine shrimp Artemia salina nauplii (within 48 h of hatching) or nauplii (less than 24 h old) from Daphnia magna or D. longispina, or even Acartia tonsa nauplii. How it works? - First it is necessary to extract the characteristic signal from sets of organisms belonging to each of the species involved in the study; this is done with a software based pattern identification and recognition procedure using training sets of organisms of each species, which will provide the tools for pattern recognition in the subsequent tests. The dedicated software will proceed with pattern recognition and differentiation, providing counting and body length for every single organism under test, either being from different species, presenting sub-totals – by species – and/or total counting when required. The application of these device in bioassays does not alter the requirements of the standardized methods. The device is easier to apply, saves time and it adds accuracy and objectiveness, comparing the sensitivity of various bioassays involving a single or several species, being tested independently or in mixed sets of organisms from more than one species.

270 Ceriodaphnia is equisensitive to Daphnia and should fulfill invertebrate regulatory toxicity requirements

K.A. Connor, S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; The OECD 202 Acute Daphnia Toxicity Test: The Comparative Species Sensitivity Test requires the use of Daphnia magna or another “suitable Daphnia species. (e.g., Daphnia pulex)”. The zooplankton Ceriodaphnia dubia is not considered a standard test species for chemical registration in Europe despite the availability of ISO and USEPA standard acute and chronic test methods and its wide use and acceptance in other countries. Standard acute assays conducted with C. dubia submitted to fulfill REACH dossiers can only be used as supporting or weight of evidence studies and not as key test. Then, simply present the battery of exposures (mixed species or single) to the test device by just pouring the (tens of) flasks to the serialization component in the D counter device. The dedicated software will proceed with pattern recognition and differentiation, providing counting and body length for every single organism under test, either being from different species, presenting sub-totals – by species – and/or total counting when required. The application of these device in bioassays does not alter the requirements of the standardized methods. The device is easier to apply, saves time and it adds accuracy and objectiveness, comparing the sensitivity of various bioassays involving a single or several species, being tested independently or in mixed sets of organisms from more than one species.

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Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (II)

Poster spotlight: TU001, TU002, TU003

58 SETAC Europe 28th Annual Meeting Abstract Book
Assessment and management of stormwater on sediment recontamination due to metal contaminants

J. Drvencanská, Texas Tech University / Department of Civil Environmental and Construction Engineering; B. Rao, Texas Tech University / Department of Civil Environmental and Construction Engineering; M. Rakowska, Texas Tech University / Civil and Environmental Engineering; M. Bejar, Texas Tech University; D. Athanasiou, Texas Tech University / Civil, Environmental, and Construction Engineering; D.D. Reible, Texas Tech University / Civil and Environmental Engineering; G. Burton, University of Michigan / School for Environment and Sustainability; B. Chadwick, US Navy Spawar Systems Center; G. Rosen, M. Colvin, SPAWAR Systems Center Pacific; R. Pini, The University of Alabama; E. Strecker, B. Steets, M. Otto, Geoseyntec Consultants

There is a lack of understanding on the association of diffuse sources, such as episodic storm events, in the metal recontamination of sediments. The study objective is to define the effect of metals associated with storm events, with regards to the sediment recontamination in the Paleta Creek near Naval Base San Diego (NBSD), in California. Two storm-events were captured for particle size characterization and metal analysis. Receiving and outfall waters were monitored for sediment deposition, contaminant water, and porewater, using auto-samplers which were triggered at each location during two different seasons. Sediments collected in outfalls, deposition traps and sediment deposits were also subjected to chemical analysis. The fractionated water and sediment samples were processed for metal extraction using the modified EPA method 3050A and 3050B, respectively, and were analyzed using ICP-MS and MEX-R-T. The samples were analyzed for a variety of metal(loid) contaminants, as such Cu, Pb, Ni, and Th. All metals were determined by inductively coupled plasma mass spectrometry (ICP-MS). This allowed for the percentages of clay, fine silt, coarse silt and sand, which represent particles that could be most directly related to recontamination potential. The results show that over the time the contaminant loadings decreased due to reduction in particulate contaminants while the concentrations in finer, and dissolved fractions remained relatively constant. The concentrations in the largest particulates in the stormwater, but only Cd is strongly associated with sediment recontamination. Cu, Pb, and Ni are associated with the dissolved phase, fine silt and clay in stormwater and present moderate impact on sediment recontamination. In addition to showing a greater dissolved fraction it appears that the depositing loads are more influenced by resuspension and redistribution of sediment than stormwater. The Th concentration is relatively small, stormwater recontamination does not add appreciably to sediment Th. The particle associations in stormwater along with spatial distribution in sediment traps can identify sources, contributing locations and effective remedial approaches. The implications of the study, can be the development of identification tools that give information about the potential mobility-transport of the metals during storm events, identification of contributing locations, effective remedial approaches, and thus, help to propose best practices for stormwater and sediment management.

The effect of percolation and form on lead bioavailability and toxicity to Enchytraeus crypticus

L. Zhang, VU University Amsterdam / Animal Ecology; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science

In the standard toxicity tests, metals are spiked freshly into test soils as easily soluble salts. This may lead to an inaccurate estimation of metal toxicity in soil, as it may not mimic the fate of metals in contaminated fields while the counterion could also have a toxic effect on soil organisms. The present study was set up to investigate the bioavailability and toxicity of lead nitrate (Pb(NO\textsubscript{3})\textsubscript{2}) and lead oxide (PbO) to the potworm Enchytraeus crypticus freshly spiked and 18-months aged Lufa 2.2 soil, with and without leaching. Survival and reproduction after 21 d exposure were related to total, 0.01 M CaCl\textsubscript{2} extractable and porewater Pb concentrations in the soil and internal Pb concentrations in the surviving animals. For all treatments, 0.01 M CaCl\textsubscript{2} extractable and porewater Pb concentrations showed a slight decrease after percolation (Pb(NO\textsubscript{3})\textsubscript{2}) was more toxic to the enchytraeids than PbO, both for survival and reproduction and in both freshly spiked and aged soils. LC50 for the effect on enchytraeid survival, based on total Pb concentrations in the soils, did not differ for PbO after percolation in freshly spiked soils and aged soils, but increased from 1380 and 500 mg Pb/kg dry soil to 1521 and 608 mg Pb/kg dry soil in freshly spiked soils and aged soils, respectively (for Pb(NO\textsubscript{3})\textsubscript{2}, LC50 based on 0.01 M CaCl\textsubscript{2} extractable Pb concentrations presented an increase from 2.07 to 1.72 to 2.78 and 2.42 mg Pb/kg dry soil after percolation in freshly spiked soils and aged soils for Pb(NO\textsubscript{3})\textsubscript{2} and a slight decreased from 2.79 and 2.45 to 2.16 and 2.18 mg Pb/kg dry soil after percolation in freshly contaminated soils and aged soils for PbO. LC50 values related to internal Pb concentrations were (\textit{mean}±\textit{SD}) for both PbO and Pb(NO\textsubscript{3})\textsubscript{2}, and ranged from 75.6 to 81.1 mg Pb/kg dry body wt in all treatments, indicating that survival of E. crypticus was better explained from internal Pb concentrations in the worms than from total or available Pb concentrations in the soil. In general, percolation did not affect total or Pb availability in the soil for Pb(NO\textsubscript{3})\textsubscript{2}, suggesting that the counterion might have influenced Pb toxicity when Pb salts were used in the standard toxicity tests. Thus, leaching the contaminated soils before testing or using the oxide form of metals might be good ways to get rid of the influence of counterions and increase environmental realism of laboratory toxicity studies.
metallurgical wastes

F. Gimbert, H. Gauthier-Manuel, R. Colquert, D. Radola, F. Chouteu, Q. Petitjean, University of Bourgogne Franche-Comté / UMR ChronoEnvironnement; A. Walter-Simonnet, University of Bourgogne Franche-Comté, UMR UFC/CNRS 6249; H. Laurent, DRAC Bourgogne Franche-Comté; A. de Vaulxfeul, University of Franche-Comté / Department of Chrono-Environment

In recent years, the development of waste has been significantly influenced by metal resources through mining and metallurgical activities, for instance, of lead (Pb), silver (Ag), or iron (Fe). However, they can lead to a significant environmental contamination through the emission of metal-rich particles and wastes. In the region Burgundy Franche-Comté (eastern France), iron mining and metallurgical activities were dominant over the Middle-Age period, especially in the ancient district of Bourgogne. Preliminary analyses highlighted anomalous manganese (Mn) concentrations in soils surrounding medieval slag heaps. Therefore, this study aims at assessing the origin and fate of this Mn using combined physical, chemical and biological tools. For this purpose, we carried out three interdisciplinary and complementary approaches: i) mineralogical characterisation of slag (identification and mapping of their composition by XRD and SEM-EDS); ii) chemical extractions for the assessment of total and available Mn concentrations in soils and iii) environmental bioavailability of Mn using toxicityokinetics (28 days) in Cantarea aspersa snails exposed to soils from 10 ancient sites of slag deposit (dated from the 5th to the 11th century) or fed with slag fragments incorporated in their diet. We identified olivine (fayalite) as the main Mn carrier in slags where its concentration reaches 4.5 wt.% MnO. With time, slag weathering, as testified by the formation of serpentine, a decay product of fayalite, leads to the release of Mn which accumulates in soils (up to more than 8000 mg kg⁻¹). Extractible concentrations of Mn from soils (mainly bound to organic matter and under reducible forms) are elevated and may represent a potential toxic exposure to soil invertebrates, raising the question of Mn bioavailability in soils and slag fragments. The modeling of Mn accumulation kinetics in C. aspersa snail tissues allowed to show that the lowest Mn concentration in snails exposed to field soils invertebrates and ii) the snail ability to efficiently regulate this element. Nevertheless, when animals are directly exposed to slag fragments incorporated in their diet, the physiological mechanisms of Mn management are rapidly overloaded and internal concentrations increase up to 3000 mgso₄kg⁻¹. Hence, in slags, although often considered as inert materials, Mn turns out to be bioavailable to snails, particularly through their alteration in situ (field) and in vivo (digestive tract).

277 Chemical and ecotoxical effects of the use of residues from the pulp and paper industry for the remediation of soils degraded by mining activities

P. Alves, H. Nogueira, Department of Biology & CESAM - University of Aveiro / Department of Biology and CESAM; H. Nogueira, Universidade de Aveiro / Department of Chemistry; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University; N. Abraites, University of Aveiro / CESAM/DAO; A.M. Gonçalves, MARE, Dep. of Life Sciences, Coimbra University/Biologia Department & CESAM, Aveiro University

The accumulation of plastics in aquatic systems, especially, microplastics (particles with < 5 mm) is of particular apprehension since they can reach high densities, derive from a variety of sources and can interact with biotic and abiotic environment. These micro/nano (particles (MPs) differ in their physico-chemical properties (e.g. size, shape, colour, density and polymer type) as well as in their origin (primary or secondary). Notwithstanding, the occurrence of microplastics (MPs) in freshwater systems is less understood than in marine environment. Hence, the present study aims to fill this knowledge gap providing new insights into MPs contamination in Antiu river in to water and sediment samples collected in March and October of 2016 in several stretches of the river. The abundance of MPs reached 14.3 ± 18.3 mg m⁻³ or 306.4 ± 472.1 items m⁻³ in water samples and 35.8 ± 25.7 mg kg⁻¹ or 318.9 ± 246 items kg⁻¹ in sediments. It shows that this river is severely influenced by MPs, especially in water compartment. Spatial and temporal distributions show different pattern according to seasonal conditions, proximity to urban areas and flow velocity. The water and sediment samples with the greatest abundances were São João da Madeira and Agucinheira, respectively. In water compartment, the highest abundance of MPs was observed in October, while in sediments an opposite pattern was observed. Analysis of plastics by Fourier transform infrared spectroscopy (FTIR) underline polyethylene (PE) and polypropylene (PP) polymers as the most common types covering more than 50% of all polymer types identified. Furthermore, the low medium high oxidation ratio for these particles were 54.38% for PE and 47.69% for PP. This indicating that fewer particles are highly oxidized. Foams and fibers were the most abundant type in São João da Madeira, while fibers and fragments are the most abundant in Agucinheira and Estarreja in water and sediment samples, respectively. Since Portugal is the 12th country in Europe with the highest plastics demand (≈1 mt) and 10%-50% of plastic go to landfills, it is urgent to monitor its freshwater systems. This study emphasizes also the importance of rivers as potential cartridge systems of MPs within environment. Further studies should be performed to identify point sources in order to mitigate the MP contamination in aquatic systems.

278 Microplastics in German rivers - first monitoring results


Microplastics are an indispensable component of our daily lives due to their diverse applications. In consequence of improper handling or disposal, plastics can enter surface waters and persist over a long period due to their low degradability. About 4.8 to 12.7 million tonnes of plastic waste are released into the oceans each year. Rivers and wastewater discharges may contribute significantly to the contamination of the marine environment. Despite an obvious causal link between the (micro)plastic load of inland waters and marine ecosystems, European rivers have been investigated for the presence of microplastics (MPs) only recently. However, the analytical results of different studies are usually not comparable among each other due to different methods of sampling, processing and analysis of microplastics. In Germany, five federal states initialised monitoring programmes to get a first overview on the microplastic load of inland water systems: Baden-Württemberg, Bavaria, North Rhine-Westphalia, Hesse and Rhineland-Palatinate in cooperation with the University of Bayreuth. Monitoring was carried out in terms of (i) novel approaches to sample collection, and (ii) lab-based analytical approaches. The programme comprised microplastic monitoring in two large river basins (Rhine and Danube), including tributaries of various sizes, thereby covering a wide range of hydrological conditions and anthropogenic influences. A total of 52 measuring points distributed over 25 rivers and streams were examined for MPs near the water surface. MPs were sampled via MantaTrawl and analysed by FTIR spectroscopy. All of these samples were analyzed and could be clearly identified as plastic particles and were characterized in terms of polymer type, size and shape. To our knowledge, the study of the five federal states in cooperation with the
University of Bayreuth represents one of the most comprehensive measuring programs in fluvial systems regarding the number of sample sites and the analytical accuracy. Excerpts of the study, focusing on particle number, distribution of size classes, particle shapes and polymer types at the water surface of rivers in western and southern Germany will be presented.

Exploring the relation between plastic concentration and river discharge in an urban river
S. Wagner, Helmholtz Centre for Environmental Research GmbH - UFZ / Department of Environmental Geoscience; P.E. Klöckner, Helmholtz Centre for Environmental Research GmbH - UFZ / Analytical Chemistry; C. Schmidt, Helmholtz Centre for Environmental Research GmbH - UFZ / Hydrogeology; T. Reemtsma, Helmholtz Centre for Environmental Research / Department Analytical Chemistry

Rivers play a major role in transport of plastic debris from inland sources into the marine environment. Presently the relevance of various individual sources and emission pathways of plastic in rivers such as wastewater treatment plants, combined sewer overflows, surface runoff and littering can hardly be quantified. Therefore plastic emission from sub-catchments are determined by integral approaches. This study examines plastic particle concentration upstream (P1) and downstream (P2) of an urban subcatchment and establishes relationships between river discharge and plastic concentration (c-Q relationship). Suspended material > 500 µm was sampled at two sampling sites in the Parthe River, (Leipzig, Germany) and downstream (P2) and has been associated with wastewater treatment plants of different discharge conditions during 17 campaigns each for 24 h. Plastic material was extracted and quantified in the suspended matter using particle size fractionation, density separation and particle cleanup followed by Raman spectroscopy. Plastic particle mass and number concentration were determined and it was observed that plastic concentration and load increased in the urban subcatchment. To explain the observed concentration and load increase of plastic input in both subcatchments was related to the catchment attributes population, catchment size, urban area, and river length revealing that population determines plastic emissions. The log-log c-Q plots of total plastic mass and particle number concentrations show an enrichment pattern at P2, hence increasing concentration with increasing discharge (positive slope b of the regression). At P1 no significant c-Q relationship was observed. This indicates that in the rural sub-catchment increasing discharge does not drive an increased mobilization of plastic material. The c-Q relationship was applied to estimate the yearly plastic emission based on river discharge data.

Microplastic pollution in upstream river catchments
T. Stanton, M. Johnson, P. Nathanail, The University of Nottingham / School of Geography; R.L. Gomes, The University of Nottingham / Faculty of Engineering; W. Macnaughton, The University of Nottingham / School of Biosciences

Microplastic particles (< 5 mm) are known to pollute large lakes and river systems globally, where their presence has barely been investigated. A large part of microplastics, particularly for low-density polymers. With the high mobility, discharges from stormwater ponds will potentially affect adjacent environmental compartments.

Microplastics in stormwater ponds
F. Liu, Aalborg University / Civil Engineering Department; K.B. Olesen, K.B. Olesen, Aalborg University / Department of Civil Engineering; M. Simon, Aalborg University / Civil Engineering Department

Stormwater runoff contains pollutants from land surfaces. As the majority of production and consumption of synthetic polymers is happened on land, micropolastic (MP) is one group of problematic pollutants in urban stormwater runoff. However, MPs in stormwater has barely been investigated. A large part of the urban stormwater runoff is treated in retention ponds prior to discharge. This study looked into the occurrence, composition and concentration of MP in stormwater ponds, aiming to evaluate the retention efficiency of MP by these systems. The results will contribute to the understanding of MP emission from urban areas, and potential impacts on adjacent environmental compartments. Seven stormwater ponds in Denmark were selected as study sites. Surface water was collected using a pumping system equipped with a 10 µm mesh stainless filter. Sediment samples were collected using an Ekman bottom grab sampler. The filters from the water samples were pre-oxidized with H2O2, followed by enzyme treatment. secondary oxidation was applied afterwards. Inorganic particles were separated by density separation using ZnCl2. Sediment samples were freeze dried and incubated in SDS solution. Enzymes were then added, followed by density separation using ZnCl2. After extraction, particles (from 10 to 2000 µm) were concentrated in 50% ethanol solution. A sub-sample was deposited onto a ZnSe window and dried. The window was scanned by micro-Fourier Transformed Infrared Spectroscopy imaging applying an Agilent Cary 620/670 system with a 128x128 pixel FPA. The software MPHunter was used to interpret spectrums. MPs were detected in water phase of all ponds. The most abundant polymers were PP, PE and PS. The highest concentration in terms of particle number was 10.8 particle/L, while the other 6 ponds ranged from 0.07 to 2.45 particle/L. For MP mass the highest concentration was 1.2 µg/L while the other 6 ponds ranged from 0.06 to 0.4 µg/L. High density polymers were also detected in some of the ponds, this is likely due to the resuspension of sediment by wind and traps of MPs by organisms. Sediment samples are still under processing and will be included in the final presentation. Nevertheless, the water samples have shown that stormwater pond do not retain all MPs, particularly for low-density polymers. With the high mobility, discharges from stormwater ponds will potentially affect adjacent environmental compartments.

Towards a more realistic assessment of microplastics as pollutant transporter: a combined experimental and modelling study
S. Seidensticker, C. Zarfl, O. Cipka, P. Grathwohl, Eberhard Karls Universität Tübingen / Center for Applied Geoscience

This study is aimed to perform a source apportionment of PM10 concentrations in four sites in Southern Italy
D. Centini, Istituto di Scienze dell'Atmosfera e del Clima, CNR / Division of Lecce; D. Cesari, E. Merico, Instituto of Atmospheric Sciences and Climate, CNR; F.M. Grasso, A. Dinozzi, Instituto of Atmospheric Sciences and Climate, CNR / Division of Lecce; A. Genga, M. Siciliano, University of Salento; M. Berico, A. Malaguti, ENEA / SPT-MET-INA. Via Martiri di Monte Sole 4, 40129 Bologna, Italy

This study is aimed to perform a source apportionment of PM10 collected simultaneously in four sites located in the Puglia region (South-Eastern Italy). The
sites are located in the area surrounding the “Federico II” coal-fired power plant. The studied area included the territory of the Province of Brindisi, close to the coal-fired power plant “Federico II”, and in the territory of the Province of Lecce at about 26 km SSE of the power plant. The Lecce site was included to assess the impact of the power plant emissions at middle distances. The measuring sites are Lendinizio (LN), Cisternino (CT), Torcianoro (TR) and Lecce (LE). The Lecce site is a previously observed site by ICAR-CNR, Central Observation station of the Global Atmosphere Watch (GAW-WMO) program. Daily PM2.5 samples were collected at the different sites during measurement campaigns in different seasons (summer, autumn and winter) between 2013 and 2016. Specifically, three measurement campaigns were performed simultaneously at the four sites in 2016 and the dataset was enriched with previously available data collected in 2013 and 2015 at the sites in the province of Brindisi (LN, CT, and TR) for a total of 457 daily samples. Collected samples were chemically analyzed to determine 19 species: the carbonaceous components (EC and OC); the water soluble ions Cl, NO3, SO4, Na+, NH4+, K+, Mg++, Ca++; the elements Al, Si, Ti, V, Mn, Fe, Ni, Cu and Zn. Measured data was used for source apportionment of PM10 based on a receptor-oriented model approach that integrates the results obtained using the receptor oriented model approach that integrates the results obtained using the receptor oriented model approach that integrates the results obtained using the receptor oriented model approach that integrates the results obtained using the receptor oriented model approach that integrates the results obtained using the receptor oriented model approach that integrates the results obtained using the receptor oriented model approach that integrates the results obtained using the receptor oriented model approach that integrates the results obtained using the receptor oriented model approach that integrates the results obtained using the receptor oriented model approach that integrates the results obtained using the receptor oriented model approach that integrates the results obtained using the receptor oriented model approach. This approach allows to estimate the primary contribution of the power plant to PM10 and to obtain an estimation of its contribution to secondary sulphate.

285 Air pollution toxicity: is it the right time to leave the bench for the field? A case study integrated approach

M. Gualtieri, ENEA / MET-INAT, F. Costabile, CNR / ISAC - Italian National Research Council, Institute of Atmospheric Science and Climate, Rome, Italy; M. Grollino, ENEA / SSPT-TECS-BIORISC Via Anguilarello, 301, 00123, Rome, Italy; P. Avino, INAIL / Department of Technological Innovations; Via IV Novembre 144, 00187 Rome, Italy; A. Cordelli, G. Raschella, ENEA / SSPT-TECS-BIORISC Via Anguilarello, 301, 00123, Rome, Italy; A. Malaguti, E. Petralia, ENEA / SSPT-MET-INAT Via Martiri di Monte Sole 4, 40129 Bologna, Italy; T. La Torretta, R. Stracciuauddo, ENEA; M. Manigrasso, INAIL / Department of Technological Innovations, Via IV Novembre 144, 00187 Rome, Italy; A. Wiedensohler, Leibniz Institute for Tropospheric Research / Permoserstrasse 15, 04318 Leipzig, Germany; G. Cremona, ENEA; K. Weinhold, Leibniz Institute for Tropospheric Research / Permosserstrasse 15, 04318 Leipzig, Germany; D. Li, Di Bert, CNR / ISAC - Italian National Research Council, Institute of Atmospheric Science and Climate, Rome, Italy; C. Consales, ENEA / SSPT-TECS-BIORISC Via Anguilarello, 301, 00123, Rome, Italy; M. Berico, EN - Italian National Research Council, Institute of Atmospheric Science and Climate, Rome, Italy; M. Aufderheide, CUTLEX LABORATORIES GmbH / Feedor-Lyrenen Straße 21, 30625 Hannover, Germany; G. Gobbi, CNR / ISAC - Italian National Research Council, Institute of Atmospheric Science and Climate, Rome, Italy; G. Zanini, ENEA / SSPT-MET Via Martiri di Monte Sole 4, 40129 Bologna, Italy

Air pollution (AP) is recognized as the most important environmental issue affecting human health. In Europe AP is responsible for 400,000 premature deaths mainly due to non-communicable diseases and disabilities. The epidemiological associations have already evidenced significant relationship between increase in risk factors for selected human diseases and air pollutants concentration. Finally IARC has classified outdoor air pollution as carcinogenic to humans (Group 1). During the last decades several toxicological studies have investigated the molecular biology of air pollutants in order to understand the critical level and to evaluate potential genotoxic or carcinogenic effects of air pollution on human health.

The aim of the present study was to assess the potential genotoxic effects of PM0.5 in different Italian towns and to obtain an estimation of its contribution to secondary sulphate.

287 Air pollution and health: early biological effects in children exposed to air pollutants and genotoxic effect of PM0.5 in different Italian towns

S. Bonetta, S. Bonetta, University of Torino / Department of Public Health and Pediatrics; M. Moretti, M. Villarini, University of Perugia / Department of Pharmaceutical Sciences; L. Covolo, University of Brescia / Department of Medical and Surgical Specialties Radiological Sciences and Public Health; M. Stagni, University of Salerno / Department of Biological and Environmental Science and Technology; M. Verani, University of Pisa / Department of Biology; T. Schiliti, C. Pignata, E. Carraro, University of Torino / Department of Public Health and Pediatrics; U. Gelatti, University of Brescia / Department of Medical and Surgical Specialties Radiological Sciences and Public Health; P. Avino, INAIL / Department of Technological Innovations; Via IV Novembre 144, 00187 Rome, Italy; A. Wiedensohler, Leibniz Institute for Tropospheric Research / Permoserstrasse 15, 04318 Leipzig, Germany; G. Cremona, ENEA; K. Weinhold, Leibniz Institute for Tropospheric Research / Permosserstrasse 15, 04318 Leipzig, Germany; D. Li, Di Bert, CNR / ISAC - Italian National Research Council, Institute of Atmospheric Science and Climate, Rome, Italy; C. Consales, ENEA / SSPT-TECS-BIORISC Via Anguilarello, 301, 00123, Rome, Italy; M. Berico, EN - Italian National Research Council, Institute of Atmospheric Science and Climate, Rome, Italy; M. Aufderheide, CUTLEX LABORATORIES GmbH / Feedor-Lyrenen Straße 21, 30625 Hannover, Germany; G. Gobbi, CNR / ISAC - Italian National Research Council, Institute of Atmospheric Science and Climate, Rome, Italy; G. Zanini, ENEA / SSPT-MET Via Martiri di Monte Sole 4, 40129 Bologna, Italy

The atmosphere is the main environment with which humans have the most direct and frequent contact. For this reason, air quality in schools, homes, offices and other indoor environments has become a major aspect of health and safety. In this study, the research team and ATMO Hauts-de-France realised two studies in the North part of France about indoor and outdoor air contamination by EDCs. According to the methodology previously validated, several types of indoor environments (office, house, scholar building and day nursery) and several areas (rural, forest, urban, industrial) were investigated over 2 years (2015 and 2016). During each season, 7 or 5 sites (indoor and outdoor) were sampling during three successive 2-week periods. The device is composed to a TSP filter system and a cartridge containing XAD resin, connected to a flowmeter and a pump. 70 EDCs were analysed by LC/MS/MS. Overall, the levels of EDCs are increasing as a result of indoor releases. The chemicals are mainly in gaseous and particulate phases separately. Whatever the site, in outdoor air as well as in indoor air, all EDCs were detected and concentrations range from 33 533 to 0.001 ng/mL. Phthalates, PAHs, musks and alkylphenols are the main compound families. Urban and industrial sites are more contaminated than rural and forest ones.

Furthermore, for most pollutants, indoor air is more contaminated than outdoor. The data also show that EDCs are not randomly distributed in the indoor environments. A correlation has been observed between the number of children and the levels of EDCs. This suggests that the use of personal care products and household products is a major source of indoor contamination by EDCs. In conclusion, the research team and ATMO Hauts-de-France realised two studies in the North part of France about indoor and outdoor air contamination by EDCs. According to the methodology previously validated, several types of indoor environments (office, house, scholar building and day nursery) and several areas (rural, forest, urban, industrial) were investigated over 2 years (2015 and 2016). During each season, 7 or 5 sites (indoor and outdoor) were sampling during three successive 2-week periods. The device is composed to a TSP filter system and a cartridge containing XAD resin, connected to a flowmeter and a pump. 70 EDCs were analysed by LC/MS/MS. Overall, the levels of EDCs are increasing as a result of indoor releases. The chemicals are mainly in gaseous and particulate phases separately. Whatever the site, in outdoor air as well as in indoor air, all EDCs were detected and concentrations range from 33 533 to 0.001 ng/mL. Phthalates, PAHs, musks and alkylphenols are the main compound families. Urban and industrial sites are more contaminated than rural and forest ones.
implementing policies of public health protection.

Source apportionment of PM near steel plant by electron microscopy

Western blot mechanism of autophagy remains largely unclear, particularly in invertebrates. In components and is involved in various biological processes including survival and

The role of the p38 activated protein kinase (MAPK) in response to Cd-induced oxidative stress. This study will contribute to a better understanding of autophagic processes in invertebrates and its modulation by environmental stressors.

291 Effects of triclosan (TCS) on antioxidant system and oxidative stress-mediated gene expression in the copepod Tigriopus japonicus J. Park, J. Lee, Sungkyunkwan University

Triclosan (TCS) is an antimicrobial agent that has been widely dispersed and detected in the marine environment. However, the effects of TCS in marine invertebrates are poorly understood. In this study, the effects of TCS on life cycle parameter (e.g. mortality and fecundity) along with cellular reactive oxygen species (ROS) levels, GSH content, antioxidant enzymatic activities, and mRNA expression levels of oxidative stress-induced defense genes, were analyzed using model marine copepod Tigriopus japonicus. The no observed effect concentration (NOEC) and median lethal concentration (LC50) of TCS in the adult stage were determined to be 300μg/L and 437.476μg/L, respectively, while in the nauplius stages the corresponding values were 20μg/L and 51.76μg/L, respectively. Fecundity was significantly reduced (P < 0.05) in response to TCS at 100μg/L. Concentration and time-dependent analysis of ROS, GSH content (%), and NOx concentrations showed that TCS caused a decrease in ROS and an increase in NO2 and NO3. Furthermore, mRNA expression of detoxification genes (e.g., CYPs) and antioxidant (e.g., glutathione S-transferase-sigma isoforms, Cu/Zn superoxide dismutase, catalase) genes was modulated in response to TCS exposure at different concentrations over a 24 h period. Our results revealed that TCS can reduce fecundity and induce oxidative stress with transcriptional regulation of oxidative stress-induced defense genes along with the activation of the antioxidant system in the copepod T. japonicus. Based on our investigation, TCS affects survival through oxidative stress with antioxidant and detoxification defense system in T. japonicus. In addition, two CYP genes (CYP3026A3 and CYP307A1) are likely to have a potential role as biomarkers in response to TCS in T. japonicus. This study will be helpful for a better understanding of how TCS affects antioxidant defense and detoxification mechanisms in copepods.

292 The protective role of multixenobiotic resistance (MXR)-mediated ATP-binding cassette (ABC) transporters in biocides-exposed rotifer Brachionus koreanus Y. Lee, H. Kang, C. Jeong, J. Lee, Sungkyunkwan University

In aquatic organisms, cellular membranes act as the final physical barrier to xenobiotics, since the membranes are in constant contact with the ambient water column that contains various anthropogenic pollutants. In this respect, the efflux activities of membrane transporters can be considered as the first line of defense to xenobiotics. Their exposure in aquatic organisms, such as biocides, is widespread in freshwater and marine environments due to their use in agriculture and aquaculture. The expression and activity of ATP-binding cassette (ABC) transporters confer multixenobiotic resistance (MXR) via their efflux activity, which enables a variety of xenobiotics to be expelled from cells. MXR has been proposed as the first line of defense against xenobiotics. In this study, the protective roles of P-gp and MRP in the rotifer Brachionus koreanus were examined in response to four biocides (alachlor, clorpyrifos, endosulfan, and molinate) using fluorescent substrates and inhibitors specific to P-gp and MRP. The efflux activities of P-gp and MRP in the rotifer B. koreanus were increased by biocide exposure, since the fluorescence intensities of the accumulated P-gp and MRP fluorescent substrates were lower in response to different biocides. Thus, exposure of rotifers to the four biocides resulted in increased P-gp and MRP activity. Moreover, the rotifers became more sensitive to the biocides, with reduced survival and slower population growth rates, when P-gp or MRP was inhibited. These findings suggest that P-gp and MRP are involved in the defense system of rotifers against biocides. Furthermore, the transcriptional levels of the genes encoding P-gp and MRP were examined to uncover the mechanism by which MXR is induced. Taken together, our results demonstrate a crucial role of the MXR efflux system in the defense response to biocides, thereby providing a better understanding of rotifer defense mechanisms on the molecular level.

293 CRISPR/Cas9 genome editing generates Daphnia magna (loss of function) mutants for TRH and ABCB1 genes. Implications for (eco)toxicological testing. C. Rivetti, IDAEA CSIC Barcelona / Environmental Chemistry; B. Campos, Unilever R&D / Environmental Chemistry; B. Pina, IDAEA-CSIC / Department of Environmental Chemistry; H. Watanabe, Osaka University / Biotechnology; Y. Kato, Osaka University / Department of Biotechnology; C. Barata, CSIC / Environmental Chemistry

Unravel the toxicological mode of action of pollutants to non-target keystone species may allow us to model and predict environmental risks of similar acting chemicals. OMICs technologies approaches developed in model
ecotoxicological species have allowed us to determine the mechanisms of action of many chemical contaminants. There is, however, the need for validated physiological studies applying reverse genomic tools. Here we present results on six CRISPR-Cas9 mutated Daphnia magna clones: three of them bearing mutations on the tryptophan hydroxylase gene (TRH), the rate limiting enzyme of serotonin synthesis, and another three having the transporter protein gene ABCB1 mutated. Bi-allelic and del del TRH mutants lack serotonin and have their growth rates impaired. Bi-allelic indel ABCB1mutants had lower transcript activity. Chronic toxicity tests with the selective serotonin reuptake inhibitor fluoxetine indicated that effects of this drug enhancing offspring production was independent of serotonin. Acute toxicity test indicated that the transporter ABCB1 is involved in the detoxification of ivermectin and its total or partial knockout dramatically increased its toxicity. These results provide the first evidence over the use of reverse genetics in Daphnia to study the mechanisms of action of toxicants opening new avenues of research in a stress physiology perspective. This work was supported by the Spanish Government grant (CTM2014-51985-R.)

294 Assessment of Effects and Recovery of Chaoborus Populations in a Novel-Concept Microcosm Experiment
C. Gamblin, R. Cockcroft, AgroChemex Environmental Ltd; W.R. Jenkins, W R Jenkins / Regulatory Affairs Ecotoxicology; S. Norman, RidgewayEco

297 Toxic mixtures in time-the sequence makes the poison
R. Ashauer, University of York / Environment

298 How to deal with mixtures of pollutants in water resource management?
R. Altenburger, UFC Centre for Environmental Research / Department Bioanalytical Ecotoxicology, M. Faust, Faust & Backhaus Environmental Consulting; A. Kortenkamp, Brunel University London; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

299 A mixture risk assessment for pollutants that reach humans via the water – fish exposure route
A. Kortenkamp, Brunel University London; M. Faust, Faust & Backhaus Environmental Consulting

Solutions for emerging pollutants - Towards a holistic chemical quality status assessment in European freshwater resources (II)

296 Linking chemical pollution and effects – How to identify drivers of toxicity?
W. Brack, M.A. Hashmi, Helmholtz Centre for Environmental Research-UFZ / Effect-Directed Analysis; M. Koenig, Helmholtz Centre for Environmental Research GmbH- UFZ / Cell Toxicology; M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; M. Muschket, UFZ- Helmholtz Centre for Environmental Research / Effect-Directed Analysis; m. muz, UFZ - Helmholtz Centre for Environmental Research / Cell Toxicology; T. Sack, Helmholtz Centre for Environmental Research / Cell Toxicology; R. Altenburger, Helmholtz Centre for Environmental Research / Cell Toxicology; C. di Paola, RWTH Aachen University / Department of Ecosystem Analysis; H. Hollett, RWTH Aachen University / Institute for Environmental Research; A. Tindall, Watchfrog S.A.

European water resources are contaminated with complex mixtures of ten thousands of chemicals among them many non-regulated compounds with emerging concern but also unknown chemicals. Chemical monitoring, however, typically considers only a very small fraction of chemicals focusing on 45 priority substances according to Water Framework Directive (WFD) together with some additional River Basin Specific Pollutants. These chemicals often do not explain effects in toxicity tests and impacts on freshwater communities. Thus, we suggest a consistent tiered approach to identify drivers of toxicity in complex environmental mixtures employing mass balance and multivariate statistical approaches as well as effect-directed analysis. The approach is demonstrated using several case studies in the Rivers Danube, Rhine, Meuse and Holtemme as examples. A specific focus is given on endocrine disruption and mutagenicity. While natural and synthetic steroids were confirmed to play a key role for endocrine disruption, the fluorescent dye Coumarin 47 has been identified as a so far unknown environmental pollutant with great ant-androgenic potency in vitro and in vivo. In a water body with direct impact of industrial effluents individual aromatic amines probably from dye production could be identified as the drivers of mutagenicity. In contrast, mutagenic effects detectable in the River Rhine receiving multiple contaminations from many sources were driven by mixture effects of industrial and natural compounds with low individual potency but strong synergistic effects when occurring together.

Poster spotlight: TU108, TU109, TU110

How to deal with mixtures of pollutants in water resource management?
R. Altenburger, UTC Centre for Environmental Research / Department Bioanalytical Ecotoxicology, M. Faust, Faust & Backhaus Environmental Consulting; A. Kortenkamp, Brunel University London; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

Chemicals in the aquatic environment do not occur in isolation but as mixtures. Their compositions, concentrations and effects are highly dynamic with regard to their temporal and spatial occurrence. Current approaches of the EU water framework directive for assessing chemical and ecological quality do not reflect the emerging challenges. The SOLUTIONS project (Brack et al. 2015, STOTEN 503:22) deconstructed the general challenge into three questions (i) How to identify priority mixtures, (ii) How to identify drivers of mixture risk, (iii) How to measure Emerging issues of carry-over toxicity amongst chemicals acting on different targets and when exposure is several days apart. It is therefore not only the dose that makes the poison but also the exposure sequence.

298 How to deal with mixtures of pollutants in water resource management?
R. Altenburger, UTC Centre for Environmental Research / Department Bioanalytical Ecotoxicology, M. Faust, Faust & Backhaus Environmental Consulting; A. Kortenkamp, Brunel University London; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

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PBDE in fish. We then make an attempt to expand the assessment by integration across these pollutant groups. While the definition of Quality Standards for specific pollutant groups is a step in the right direction, our analysis shows that more efforts are needed to protect humans from possible combination effects across pollutant groups. Such efforts are currently hampered by data gaps concerning common toxicities likely to arise in humans.

300 An Advanced Methodological Framework for the Identification of Priority Pollutants and Priority Mixture of Pollutants in European Freshwaters

M. Faust, Backhaus & Environmental Consulting; R. Altenburger, UBC Centre for Environmental Research / Department Biocatalytic Ecotoxicology; T. Buck, University of Gothenburg / Department of Biological and Environmental Sciences; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; V. Dulio, INERIS; J. van Gils, DELTARES; A. Ginebretè, CSIC - Spanish National Research Council / Environmental Chemistry; A. Kortenkamp, Brunel University London; J. Munthe, IJLV, Swedish Environmental Research Institute Ltd; J. Slobodnik, Environmental Institute; T. Seiler, RWTH Aachen University / Ecosystem Analysis; P. van den Brink, and A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health

We present a proposal for an advanced methodological framework for identifying priority pollutants and priority mixture of pollutants in European freshwater. The proposal was developed by the EU project SOLUTIONS. It aims to tackle major shortcomings of current prioritisation procedures under the EU Water Framework Directive (WFD). To include high data throughput, it prioritised funds for a research conclusion that cannot be met. Significant risks from so-called emerging pollutants may remain undetected. The WFD does not include an effective mechanism to close such knowledge gaps. The introduction of a watch-list mechanism for up to 10 substances provided a minor improvement but no fundamental change to this situation. (ii) Individual pollutants are assessed as if they would occur in isolation, largely ignoring the fact that they are part of complex multi-constituent mixtures. Environmental quality standards that have been established for single priority pollutants may not be sufficiently protective against mixture effects. Regulatory approaches for effectively tackling the problem are missing. The advanced framework integrates all available lines of evidence (LOE) on significant risks. This includes evidence from (i) ecotoxicological monitoring (field observations on so-called biological quality elements), (ii) effect-based monitoring (in vitro or in vivo testing in the lab or onsite), (iii) chemical monitoring in combination with so-called component-based mixture risk assessment approaches, (iv) integrated modelling of co-exposure and resulting mixture risks. Where one or more lines of evidence identify groups of pollutants presenting a significant risk, those would be prioritised for risk reduction measures. Where appropriate, such groups may be reduced to few mixture components or even one single component which can be demonstrated to explain most of the overall risk, so-called drivers of mixture risks. Wherever conclusive evidence on significant risks and needs for risk reduction cannot be reached because all possible LOEs are somewhere blocked by significant data or knowledge gaps, mixture components of potential concern are not left unnoticed but they are prioritised for further research and testing. Some elements of the advanced methodological framework may be readily applicable under the existing WFD. Full implementation, however, requires changes in the legal text, as detailed in Brack et al. 2017 (Sci Total Environ 576:720-737).

301 A diagnostic toolbox for ecological effects of pollutant mixtures: a case study application using in situ experiments with microbial communities

T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; A. Arrenhius, University of Gothenburg / Biological and Environmental Sciences; R. Behra, Eawag / Department of Environmental Toxicology; T. Seiler, RWTH Aachen University / Ecosystem Analysis; P. van den Brink, Alterra and Wageningen University; B. Deutschmann, RWTH Aachen University / Department of Ecosystem Analysis ESA; N. Corcol, University of Gothenburg / Department of Biological and Environmental Sciences; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Analysis; S. Teachenor, Eawag, Water Environmental Chemistry; H. Rollert, RWTH Aachen University / Institute for Environmental Research; H. Segner, University of Bern / Centre for Fish and Wildlife Health; I. Teodorovic, University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology (LECOTOX); A. Tili, Eawag / Department of Environmental Toxicology; B. Wagner, Swiss Federal Institute of Aquatic Science and Technology (EAWAG) / Department of Ecotoxicology; A. Tili, Eawag / Department of Environmental Toxicology

A toolbox for the detection of ecological impacts of chemicals was developed using a statistically supported, transparent and formalized weight of evidence (WOE) approach. It integrates four lines of evidence (LOE’s): (i) predictive mixture modelling, (ii) effect-directed analysis (EDA), (iii) in situ tests, and (iv) field-based monitoring studies. A systematic and quantitative method was developed for the aggregation of multiple in situ tests into LOE III, using an aggregated response index, which we termed the “average biomarker response” (ABR). The results of the four separate LOE’s are finally integrated using a systematic decision matrix that provides the main overarching conclusions that can be drawn from a given set of data and that pinpoints to critical data gaps. Here we first present an overview of the toolbox. Afterwards, we present a case study that used in situ experiments with photoautotrophic biofilms (periphyton) in wastewater impacted streams. Chemical-analytical profiles initially showed clear differences of the micropollutant load in the water up- and downstream of the entry point of a sewage treatment plant effluent. These chemical-analytical data were evaluated for their potential to ecotoxicological effects by using effect-based monitoring approaches. Based on outcome of this LOE, we hypothesized that clear ecological effects on the structure and function of the exposed microbial communities should be present. Indeed, these were then confirmed using the concept of pollution-induced community tolerance (PITC). In the end, the study allowed us to demonstrate that (i) the STP effluent actually caused ecological impacts on the exposed microbial community (ii) a subsequent upgrade of the STP plant with activated carbon filtration led to a recovery of the community that was driven by a lowered overall toxic pressure, (iii) PSII inhibitors were the mixture toxicity drivers, and (iv) that ecologically relevant effects go beyond a mere toxic unit summation. The presented work was a joint effort of the EU funded project SOLUTIONS, the ERAfresh project that was funded by the Swiss Federal Office for the Environment, and the IMPROVE project, which is funded by the Swedish Research Council.

302 Derivation, Validation and Implementation of Environmental Quality Benchmarks

302 Questioning annual average concentrations for plant protection products - TKTD modelling of real exposure profiles

M. Junghans, Swiss Centre for Applied Ecotoxicology EAWAG - EPF / Ecotox Centre; R. Kuhl, E. Zimmer, IBACON GmbH; I. Werner, Ecotox Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology; R. Ashauer, University of York / Environment

The EU Water Framework Directive defines two environmental quality standards for assessing the chemical status of surface waters. The MAC-EQS defines the Maximal Allowable Concentration that should never be exceeded and the AA-EQS defines a concentration that should be exceeded by the Annual Average concentration. While the MAC-EQS should account for the acute toxicity of a substance, the AA-EQS is based on chronic ecotoxicity studies. For substances with highly fluctuating environmental concentrations like plant protection products the use of the annual average is disputed. Hence, in Switzerland it was suggested to use 14 day time-weighted average (TWA) concentrations for assessing compliance with quality standards for chronic toxicity. This approach is based on the average duration of chronic ecotoxicity tests and Haber’s rule. We assess the suitability of this approach for retrospective risk assessment by applying toxicokinetic-toxicodynamic (TKTD) modelling on high resolution exposure profiles of plant protection products measured in Swiss streams. The TKTD modelling is a proxy for the actual time-course of toxicity under time-variable exposure and is based on 7 species, 7 substances and 5 exposure profiles from 5 streams. The results confirm the suitability of the time integral of 14 days. The prediction of actual toxicity for the most toxic periods is very consistent with the toxicity modelled for the TWA. The deviations are on average less than factor 2 for each organism group tested. In addition to mortality for crustaceans and fish, only a small selection of sub-lethal effects was considered, namely reproduction and growth. Plant water fleas and duckweed, growth in duckweed and algae. Two studies also show that comparing quality criteria for protection against acute effects (MAC-EQS) to time-proportional 3-day mixed samples is appropriate.

303 Revision of 62 Environmental Quality Standards - lessons learned

M. Junghans, Swiss Centre for Applied Ecotoxicology EAWAG / EPF / Ecotox Centre; R. Kase, Swiss Centre for Applied Ecotoxicology Eawag-EPFL; I. Werner, Ecotox Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology

Environmental Quality Standards (EQS) are ecotoxicologically based threshold values that aim to prevent harmful effects of pollutants on ecosystems. Similar values exist in Switzerland and the Federal Office for the Environment recently commissioned the revision of existing EQS for 62 substances to ensure that they are based on the current state of science. This study aimed to analyse the underlying reasons for numerical changes of EQS and to highlight knowledge gaps. As for the original EQS derivation, relevant data were retrieved from databases, the public literature and Toxicokinetics, provided by manufacturers. The reliability and relevance of ecotoxicological data were assessed using the CRED method. EQS derivation then largely followed the EU-Technical Guidance for Deriving EQS. After the revision, 60 AA-EQSs and 58 MAC-EQSs were proposed. The EQS revision did not generally lead to either lower or higher EQSs. AA-EQSs increased in 13 cases (max./median fold change +9.6/3.3) and decreased in 18 cases (fold change -1.9/-1.3). MAC-EQSs increased in 21 cases (50/61.8) and decreased in 9 cases (22.7/2.4). Most EQSs were derived deterministically, using the assessment factor (AF) method. Due to an increase in data for some
substances, the number of AA-EQSs and MAC-EQSs derived using Species Sensitivity Distributions (SSDs) increased from 2 to 5 and from 7 to 11, respectively. For AA-EQS derivation, AF were reduced in 12 cases and increased in only 6 cases. For the MAC-EQS derivation, AF were reduced in 5 cases and increased only in one case. Our study demonstrates that EQSs based on small data sets are more prone to large numerical changes when revised. Hence, an update often results for substances associated with the derived EQSs, as evident from application of lower AFs and more frequent EQS derivations based on SSDs. This is likely to make EQSs more robust against larger changes in future revisions. Nevertheless, for the majority of the substances considered in this study, data sets were insufficient to construct SSDs. This is mostly due to a lack of studies using non-standard test species and species from important taxonomic groups, such as amphibians or invertebrates. Further, changes in the recommended action of a substance, this factor alone prevented the use of lower AFs. Finally, recommendations regarding assessability and quality of ecotoxicity data from industry studies and from the scientific literature are presented.

304 Endocrine disrupting properties: how far and consistent they are considered deriving Water Framework Directive Environmental Quality Standards? A case study tackling French and EU EQS values A. James-Casas, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances ETES; A. Bothamy, INERIS; S. Andres, INERIS / Toxico logical Ecotoxicological Assessment of chemical Substances ETES; A. Bothamy, INERIS. Group 4 (contingency) all chemicals should be tackled in diverse regulatory frameworks, among which the Water Framework Directive Common Implementation Strategy (WFD CIS). In this context, endocrine disruption (ED) is quoted several times as an issue for deriving water quality thresholds in the European Commission Technical Guidance for Deriving Environmental Quality Standards (TDG EQS). However, even if this guidance includes ED properties as a reason for growing concerns, it does not properly recommend any specific methodological approach to consider these properties while deriving EQS values. In order to evaluate the usefulness of such a recommendation and the extent to which it should be implemented, a state of the art of how ED properties are currently being taken on board at EU and national level was made. To begin with, the work consisted in carrying out an inventory of substances for which an ED threshold has been derived and a factsheet describing the reasoning behind value was available. These substances made up the universe of 178 substances on which further work was led. Then, an analysis was made of these substances EQS derivation to categorise them according to how ED properties were reported and taken on board if necessary for protection of wildlife and human health. This work led to 4 groups of substances. Group 1 contains substances whose EQS values do not consider ED effects, and which need to be reassessed as a matter of priority. Substances for which EQS derivation has considered ED effects but whose rationale does not clearly explain this are grouped together in Group 2 and should be verified. Group 3 corresponds to substances whose ED characteristics have been considered by an additional safety factor and/or in a case by case basis. Group 4 consists of all chemicals that have no ED effects demonstrated from now on. No action is required for these last two categories. This state of play and categorisation work made it possible to prioritise substances for which EQS should be updated first as regards their ED potential. Also, this work gives more insight in how to derive EQSs as regards ED potential in order to further propose recommendations for a harmonisation of the methodology in the future.

305 Bringing water quality benchmark derivation approaches into the 21st century K.A. van Dam, Environmental Research Institute of the Supervising Scientist / Department of the Environment and Energy; G.E. Batley, CSIRO Land and Water / Centre for Environmental Contaminants Research; R. Fisher, Australian Institute of Marine Science; D. Fox, Environmetrics Australia; A.J. Harford, Environmental Research Institute of the Supervising Scientist / Department of the Environment and Energy; C.L. Humphrey, Environmental Research Institute of the Supervising Scientist / Department of the Environment and Energy; A.K. Robinson, Antarctic Division / Department of the Environment and Energy; J. Stauber, CSIRO / CSIRO Land and Water; M.S. Warne, Coventry University / Centre for Agroecology, Water and Resilience The most common method for deriving water quality benchmarks (WQBs) for toxicants is the use of a species sensitivity distribution (SSD) to estimate a benchmark for the most susceptible species. For example, only 5% of species are contained in the specific of the methods employed by jurisdictions around the world, the fundamental SSD approach is similar and, moreover, has not changed markedly over the past 20 years, despite a significant body of published research aimed at improving or developing new derivation methods. The recent revision of the Australian and New Zealand SSD-based derivation method has re-highlighted numerous limitations of the SSD approach for certain data situations and toxicant types; for example, small sample sizes, model choice and fit, and accommodating different routes of exposure (e.g. for persistent, bioaccumulative and toxic compounds) and specific mechanisms of toxicity (i.e. biomodality). However, areas for improvement of WQB derivation methods extend beyond just refining SSD-based approaches, to the use of non-SSD approaches and weight of evidence approaches that give consideration to both laboratory- and field-effects data. Other opportunities for improvement exist in the acquisition of data for WQBs (e.g. type and acceptability of toxicity data), as well as the application of WQBs in water quality management. Thus, it is important to identify and target the limitations that, if addressed, will yield the biggest benefits to environmental protection. Experience has shown that a ‘one size fits all’ approach to WQB derivation does not work, and an alternative is to provide flexibility and adopt approaches that do the best job in the face of the specific conditions and uncertainty posed by different situations. However, this may increase the complexity of the derivation process and, thus decrease understanding and adoption by users. This presentation will examine a variable data cases associated with WQB derivations and present an idea of what research efforts have been undertaken to significantly evolve the way we derive WQBs? To what extent have the outcomes of this research been adopted in formal derivation methods? Why has the fundamental SSD approach not changed markedly over the past 20 years despite various proposed improvements? Do we need to move to a new generation of WQB derivation approaches and, if so, what are the aspects that will have the biggest impact, and the criteria that would make new approaches amenable for adoption?

306 The quest for consistent environmental protection: the challenge of variable water quality guidelines between regulatory jurisdictions G. Merrington, A. Peters, wca; S. Kosmala, WCA Environment Limited One of the tools used by regulatory jurisdictions to deliver environmental protection is Water Quality Guidelines (WQGs) or Environmental Quality Standards. These are thresholds expressed as a chemical concentration, with an associated summary statistic (e.g. maximum) and period (e.g. “annual average”). These thresholds are used around the world for a number of purposes including to assess water quality, to determine and set effluent discharge permits. Historically, most regulatory jurisdictions across the globe have, at the very least, WQGs for some trace elements. The perceived challenge for many in the regulated community, especially multinational organisations, is the lack of transparency in derivation and implementation of WQG within a regulatory jurisdiction and the inconsistent environmental protection levels between regulatory jurisdictions, despite having the same protection goals. Here we will address the veracity of that perception and attempt to understand its source. There is limited consistency in environmental protection, as judged by WQG for the same trace element, across regulatory jurisdictions. The absence of robust protocols (or any protocols that can be reviewed) for the derivation is a major factor as is the inevitable lack of resources and time for many regulators to update WQG and account for new scientific developments. There are unfortunate repetitive cycles of derivation that each jurisdiction goes through for the same substances and perhaps there is benefit in sharing knowledge and understanding across jurisdictions that would deliver consistent and transparent levels of environmental protection.

307 A Call for Greater International Collaboration in Developing Environmental Quality Benchmarks: Many Hands Make Lighter Work! M.S. Warne, Coventry University / Centre for Agroecology, Water and Resilience; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science; G. Merrington, wca Environmental quality benchmarks (EQBs), also variously called guidelines, standards, criteria) are an internationally accepted means of protecting ecosystems from the adverse effects of toxicants. As such, numerous countries, states/provinces, regions, academics and consultants have developed EQBs. As a result there are numerous EQBs for the same suite of chemicals (e.g. copper, lead, benzene), each slightly different. This is a huge waste of resources. These differences arise because of the differences in the methods used to derive the EQBs, which govern what is considered acute and chronic, what data can be used, and the magnitude of assessment factors etc. The current situation with the derivation of EQBs has been compared to that of toothbrushes – “everyone has one and no-one else wants to use anyone else’s” and disagreements arise about whose “toothbrush” is the best, whether particular features are “arbitrary” etc. We believe that such attempts are unhelpful and missing the point. There have been previous calls for increased collaboration between jurisdictions and even calls to harmonise the derivation methods with the ultimate goal of having a single global derivation process and a single set of global benchmarks. While having a single derivation method and set of benchmarks is a lofty goal it is also extremely unlikely to occur widely across the globe. The greenprints are possible for parts of the derivation process that takes the most time and effort. At least 90% of the time and effort spent on deriving an EQB is used to assess which ecotoxicity data are suitable and of appropriate quality to use. We therefore advocate that efforts should focus on these methods. Possible ways to reduce effort include: acceptance of other jurisdictions assessments; international acceptance of an existing method; developing a new assessment method and establishing an international archive for assessed data. Other components of the derivation process that could also be relatively easily harmonised and would have a significant impact in reducing effort will also be discussed. A realistic plan for achieving these gains will be set
out.

Microbial community ecotoxicology in environmental risk assessment and ecosystem monitoring

308 The impact of anthropogenic activities on bacterial and viral diversity in the Eastern Mediterranean Sea
A. Tsiora; P. Pitta, Hellenic Centre for Marine Research Crete / Institute of Oceanography and Environment; S. Fodellanakis, G. Michoud, King Abdullah University of Science and Technology; A. Pavlidou, E. Rousselaki, N. Simboura, Hellenic Centre for Marine Research; C. Zeri, Hellenic Centre for Marine Research / Institute of Oceanography; F. Karakasis, University of Crete / Department of Biology; G. Kotoulas, Hellenic Centre for Marine Research; D. Dalfoncio, 4King Abdullah University of Science and Technology / Biological and Environmental Sciences and Engineering Division; M. Tsapakis, Hellenic Centre for Marine Science / Institute of Oceanography

The Eastern Mediterranean Sea is a low-nutrient low-chlorophyll marine ecosystem [1] but some variability within the basin does exist. Indeed, several coasts are influenced by anthropogenic processes, and specifically in the Greek coasts these include industrial, harbor, agriculture, mariculture activities, urbanization and tourism [2]. Our hypothesis was that prokaryotic and viral community diversity is differently affected in contrasting coastal systems by anthropogenic pressures. We used 16S rRNA gene amplicon and whole virome sequencing at stations characterized by different chemical features based on the “National monitoring project for the implementation the Water Framework Directive (2000/60/EE) in Greece” [2]. We focused on viral auxiliary metabolic genes and the influence of heavy metals (Cu, Cd, Co, Ni, Pb, Zn, Cr and Hg). Significant differences were found at the genus level between the sampling stations. Proteobacteria were dominant in all stations, while Bacteroidetes were more pronounced in some of the stations. Rare phyla were higher in Echinades and Patraiko Gulf. 16S rRNA patterns resembled abiotic variables, and especially the patterns of heavy metals Cd, Cd, Cu and Pb. The highest concentrations of NO\textsubscript{3}−, NO\textsubscript{2}−, NH\textsubscript{4}+, PO\textsubscript{4}−, SiO\textsubscript{2} and chlorophyll a were found in stations influenced by extensive industrial, agricultural and maricultural activities. The 3 stations of Anavrikos Gulf were highly variable in terms of community structure. Significantly lower relative abundance of Verrucomicrobia and Bacteroidetes in the “control” than in the “impact” station in Kefalonia (inside and outside the influence of the fish farms, respectively) was seen. Bacterial 16S rRNA analysis revealed significant differences between stations along the Greek coast, suggesting that each station hosts a different community. Analysis of viral metagenomes will show if community composition reflects the anthropogenic activities in these areas, and if lysogeny (i.e. viral integration and auxiliary metabolic genes’ abundance) is a prevalent life strategy. [1] Krom MD, Emeis K-C, Van Cappellen P. 2010. Why is the Eastern Mediterranean phosphorus limited?. Prog Oceanogr 85:236-244. [2] Pavlidou A, Simboura N, Rousselaki E, Tsapakis M, Pagou K, Drakopoulou P, Assimakopoulou G, Kontoyiannis H, Panayotidis P. 2015. Methods of eutrophication assessment in the context of the water framework directive. Cont Shelf Res. 108: 156-168.

309 Impacts of stormwater on microbial community structure and function in estuarine sediments
K. Hafmuß, Macquarie University / Evolution and Ecology Research Centre; P. Steinberg, University of New South Wales / Centre of Marine Biotechnology; S.L. Simpson, CSIRO Land and Water / Centre for Environmental Contaminants Research; J. Potts, P. Scanes, NSW Office of Environment and Heritage; S.C. Birrer, University of New South Wales; M. Sutherland, NSW Office of Environment and Heritage; V.X. Simon, University of New South Wales; T. Lachnit, University of Kiel; S. Swanup, National University of Singapore; S. Kjelleberg, Nanyang Technological University / The Singapore Centre on Environmental Life Sciences Engineering; M. Doblin, Department of Environmental Sciences / Department of Environmental Sciences; G. Birch, Sydney University / School of Geosciences; P. Gribben, University of New South Wales; E.L. Johnston, University of New South Wales / Evolution and Ecology Research Centre. Estuaries are diverse and productive ecosystems that are subject to high levels of disturbance. They are exposed to multiple stressors such as legacy contaminants in sediments and ongoing inputs of nutrients and metals via stormwater, but we still have little understanding of the consequences for ecosystem functioning. We surveyed sediment communities at four locations with large stormwater drains in Sydney Harbour, Australia. Locations were either poorly-flushed embayments or well-flushed embayments. Sediments were collected monthly during base rainfall (<5mm/day) for 4 months from 3 sites within each location at increasing distance from the stormwater drain (0, 200 and 1000 m). We also collected sediments after 2 large rain events (>150mm in 24h). Next-generation sequencing was used to characterize the microbial community and sediment was subsampled for metals, total organic carbon, total nitrogen and phosphate. Sediment cores were also collected to determine chemical processes including primary productivity, community respiration and nutrient cycling. We observed major shifts in the microbial community related to exposure to legacy contaminants and new stormwater contaminant inputs. We also found trends of decreasing community respiration rates away from storm drains and lowest rates of primary production during base rainfall. The results have implications for future management of stormwater in estuaries and increase our understanding of how to conserve crucial sediment community diversity and function.

310 Drought as environmental driver on ciliates and micrometazoa communities in a multistressors scenario. An experimental approach
J. López-Duval, F. Romero, V. Acuña, S. Sabater, ICRA Catalan Institute for Water Research
Climate change will affect agriculture practices and productivity because increased intensity and frequency of drought events will increase water demand and lead to stress and diseases in plants. Further, changes in phenology, that means a future increase in the use of pesticides and, in consequence higher risk of freshwater pollution. In addition climate change will lead to higher severity of drought events and higher temperatures. Ciliates and micrometazoans in freshwater ecosystems play an important role in the processing of organic matter and as basal resource for consumer organisms. The present work aims to study how these environmental and chemical stressors, and their interactions, in a future scenario of climate change can affect these communities in freshwater sediments. To study how drought (D), warming (T) and a realistic environmental mixture of pesticides (P) can affect the communities of ciliates and micrometazoans in river sediments, we developed an experiment with a factorial design in experimental indoor channels with natural sediment from a pristine river (24 channels, 3 replicates, 8 experimental conditions). The community was exposed to the stressors for 7 weeks. Diversity of Ciliophora and micrometazoans communities was studied twice during the experiment (one week before and after 7 weeks of chronic exposure). Significant changes in community composition between pre- and post-exposure were observed for all treatments. Community was dominated by micrometazoans in all treatments in terms of density, but a trend of increasing the percentage of ciliates in these treatments with stressors was observed, indicating a possible advantage of ciliates in stressed environments. At the end of the experiment total density was significantly higher than control in D, DP and TDP treatments (p < 0.001 Dunnet’s test) while diversity was significantly higher in D, TD and TP conditions (p < 0.001 Dunnet’s test). Taking into account community composition, the effects of drought were the most important factor causing significant differences in community composition (PERMANOVA p = 0.001). The mixture of pesticides at realistic environmental concentrations did not cause any effect on the studied communities. Our results suggest that flow reduction is the main driver for changes in micrometazoa and ciliate communities in our experimental system while pesticides and temperature produce significant effects only in combination with drought.

311 Linking pesticide pollution with periphyton quality in agricultural streams: a fatty acids approach
N. Correll, University of Gothenburg / Sweden / Biological and Environmental Sciences; Håkansson, Department of Biological and Environmental Sciences; A. Nilsson, University of Gothenburg / Section of Ophthalmo, Dept. Clinical Neuroscience, Institute of Neuroscience and Physiology, Sahlgrenska Academy; K. Johansson, University of Tartu / Institute of Technology; H. Španggler, Halmstad University; M. Kahlert, SLU Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; J. Kreeger, The Society of Agricultural Sciences / Centre for Chemical Pesticides; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences
Although the environmental risks associated with pesticide pollution in agricultural streams are quite well documented, little is known about its potential effects on periphyton quality. Periphyton provides many of the essential polysaturated fatty acids (PUFA) that are needed for organisms at higher trophic levels in river food webs. This study aims to assess the effects of pesticide mixtures on periphyton quality in situ. Three streams (Höje å, Skivarpsån and M42) located in the agriculturally dominated region of Skåne (SE Sweden) were sampled in September and October 2016. The effects of pesticide pollution were assessed by passive field sampling coupled with laboratory ecotoxicity tests, by mixture toxicity modelling to predict which chemical stressors were potentially driving the toxicity, and by examining the fatty acid profiles, pigment content and algal diversity of periphyton communities. Results from water chemical analyses clearly showed higher levels of nutrients and pesticide pollution in Skivarpsån and M42 than in Höje å. Ecotoxicity tests using the passive sampler extracts demonstrated that the pesticide mixture occurring at Skivarpsån and M42 were toxic for periphyton communities from Höje å, causing an inhibition of the photosynthetic activity up to 63% and 53%, respectively. Cluster and principal component analyses based on pigments content, algal diversity and fatty acid profiles, clearly separated the periphyton from the three river sites studied. Algal biomass from periphyton polluted streams (Skivarpsån and M42) was higher than in Höje å. The nutritive quality of the periphyton differed among streams, and fatty acids considered high-quality such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) were also abundant in pesticide polluted streams (Skivarpsån and M42). Overall, even though results from the lab show that the mixture of pesticide pollution in the studied
streams might be toxic for periphyton (i.e. inhibiting the photosynthetic activity), being herbicides the driving chemical stressors. Results from the field, indicate that when the levels of pesticide pollution are low and co-occur with high levels of nutrients pollution, nutrients might mask pesticides effects on periphyton quantity and quality because compensatory effects from nutrients.

312 Estrone and triolosan mixture alters soil metagenomics during degradation
D.L. Carr, Texas Tech University / Biological Sciences; E. Osuji, Texas Tech University / Biological Science

Wastewater derived from domestic use commonly contains mixture of pharmaceutical and personal product (PPCP), but its persistence and accumulation in the soil and the consequences for soil microbial community processes are poorly understood. Estrone and triolosan are two common PPCPs of domestic wastewater. Soil microbial communities degrade a variety of PPCPs however; most studies have only addressed single compound designs neglecting the reality of their co-occurrence in nature. In this study, we examined the interaction between estrone and triolosan mixture, their potential to persist and disrupt soil microbial community composition and function. Soil was spiked with estrone, triolosan, and a 1:1 mixture of estrone: triolosan, and incubated for 90 days in the dark at 27°C. We examined soil microbial function dynamics using commercial Biolog EcoPlates™. Microbial degradation rates were compared over the 90 days’ incubation period using high performance liquid chromatography. Metagenomic analysis by 16S rRNA was used to determine changes in microbial community over time. There was a significant increase in substrate activity and substrate richness in all treatments. Each microbial community utilized different carbon substrates by day 90 whereas they had exhibited similar substrate utilization at day 0. Estrone and triolosan as single compound treatments exhibited half-lives of 6.8 days (estrone) and 26.7 days (triolosan). The rate of degradation of the binary estrone:triolosan mixture was the same as the individual compounds. There was a decrease in species diversity between control at day 0 and all other treatments at day 90 with establishment of unique OTUs in each treatment group at day 90. Metagenomic analyses indicate distinct communities by treatment 90 days after exposure even though Bacillus sp. was predominant in all the day 90 treatments. Soil microbial communities are adept at degrading estrone and triolosan in this soil whether occurring singly or as a binary mixture thus preventing accumulation in soil and subsequent contamination of ground water.

313 Poster spotlight: TU014, TU015, TU016

Integrating life cycle approaches towards a sustainable circular economy (II)

314 Region-specific life cycle inventories for tailings disposal in ecoinvent v3
D.A. Turner, EMPA / Technology and Society Lab; G. Doka, Doka Life Cycle Assessments; A. Haarman, EMPA Technology & Society Lab / Technology & Society Lab; R. Hirschier, EMPA / Technology and Society Lab

Tailings, a waste material produced during mineral concentration (beneficiation), often contain significant quantities of mobile toxic metals and are typically produced in large quantities. To manage these wastes, tailings are commonly stored behind dammed impoundments, known as “tailings ponds”. These ponds pose a significant long-term pollution risk as metals may leach out into the surrounding environment, potentially over very long timescales. The management of tailings therefore represents an important environmental burden for primary metal production. To help life cycle assessment (LCA) practitioners quantify this important environmental burden, the ecoinvent database contains a dedicated tailings emissions model. However, the dataset was intended only to serve as a first generic estimate and is therefore represents an important environmental burden for primary metal production and access to more detailed, region specific LCI data on tailings disposal is crucial for a more comprehensive and integrative examination of primary metals in LCA studies. Here, we present an extended model for assessing the long-term emissions from tailings disposal. The model can he developed a specific tailings composition and local climate data, allowing for the creation of site- specific life cycle inventories based on an extensive literature survey on data on tailings compositions and leachate concentrations from different mine sites worldwide, the model was used to develop new country- and region-specific datasets for tailings disposal from a range of ore types, which will contribute to improving the quality and hence reducing uncertainties in LCA studies worldwide. Our presentation will give an overview of the extended model and related datasets, which will be integrated in a later version of ecoinvent. We will also highlight its improvements compared to the previous model by presenting the results of an LCA case study of region-specific primary metals production in order to demonstrate the important differences between global average and situation-specific calculations in such an important sector as primary metals production.

315 Closing the copper cycle in the EU-28: scenario analysis and potentials for GHG emissions reduction
L. Ciacci, Alma Mater Studiorum - University of Bologna; F. Passarinì, Alma Mater Studiorum - University of Bologna / Dept. of Industrial Chemistry

Copper is widely used in modern society, finding application in traditional end-uses such as plumbing, infrastructure, and transportation, but it is also an essential metal in emerging green energy technologies. Europe (i.e., EU-28) has modest natural deposits and strongly depends on imports to meet the domestic demand. In view of replacement and possible supply shortages, end-of-life recycling can secure access to secondary copper forms and support the implementation of a circular economy. In addition, copper recycling is generally less energy intensive than primary copper production, closing the elemental cycle through recycling would result in significant environmental benefits. However, despite a well-established industry network in the copper value chain, the EU-28 is still far from perfect recycling highlighting wide margins for improvements. Some of these potentials for copper circularity and environmental benefits were explored combining four well-regarded UNEP scenarios with material flow analysis. For each scenario, the copper demand and supply in the region was modeled to 2050. We commented the results in the case of stationary end-of-life recycling performance and under the hypothetical implementation of a near-perfect recycling end-use cycle. The use of Life Cycle Assessment to adjust consumption taxes: The concept of Multi-Objective Reverse Supply Chain Network Design of Fluorescent Lamps with Piecewise Linear Functions
C. Leg, L. Papageorgiou, University College London / Department of Chemical Engineering; N. Shah, Imperial College London / Department of Chemical Engineering

In this study, a reverse supply chain model has been developed to support strategic decisions making problems and associated with its reverse supply chain design and operation. The examined networks comprise multi-echelons, including depots, warehouses; collection facilities, recycling plants and reuse markets connected by a transportation mode. The system is modelled as a multi-objective mixed-integer linear programming (MILP) optimisation problem allowing the inherent trade-offs between the conflicting economic and environmental objectives to be explored. The economic function is net economic indicator calculated to evaluate the total cost of the resulting production and transportation savings. Total cost includes capital and operation costs required to operate the supply chain network. The production saving is the revenue obtained from selling secondary products. In contrast, the ecological objective function is based upon net environmental value. This is achieved by adopting the principles of LCA, expanding the network boundaries to incorporate a set of life cycle stages and use loadings, and Korean Eco-Indicators for the assessment of the environmental impact of the network and avoided burdens. In addition, the environmental and economic performances of reverse supply chain networks are assessed through the development of a spatially explicit model that combines logistics and Geographic Information Systems. The model is used to address strategic decisions involving the location, number and capacity of collection and recycling facilities; selection of recycling technologies; and assignment of transportation links required to satisfy returns and demand at the markets. At the operational level, optional recycling facilities and flows of material between various components within the supply chain are determined. Furthermore, the model considers the economies of scale (large, medium and small) of collection & recycling facilities and transportation links, and explores whether centralised recycling is favoured over decentralised recycling. The criterion optimality of the proposed models is explored within a South Korea context in order to determine the optimal reverse supply chain configuration of fluorescent lamps.

317 The use of Life Cycle Assessment to adjust consumption taxes: The concept of a Damage and Value Added Tax
B. Timmermans, Université Libre de Bruxelles; W. Achten, Université Libre de Bruxelles / Department Geosciences, Environment and Society

The purpose of this presentation is to provide a short insight about a study examining the principles and feasibility of a shift from Value Added Tax (VAT) or sales tax to a Damage and Value Added Tax (DaVAT) partially based on the life cycle assessment of products and services. With this shift, goods and services that seriously harm the environment and human health will be priced up, those that have less impact will be priced down. The DaVAT system relies on three essential
points: i) Apply VAT (or consumption taxes in general) to all goods and services and reduce its multiple rates to one single low rate (e.g. 3%) called Uniform VAT (UVAT); ii) Add to UVAT a per-unit tax called Global Damage Tax (GDT) calculated on the basis of environmental impacts assessed by means of specific or generic LCAs. In the case of potentially high-polluting products or industries, a specific LCA will be automatically imposed; iii) In order to reflect environmental, social or economical critical aspects to a country, a tax called Specific Damage Tax (SDT) is proposed that extends beyond LCA. DaVAT is the sum of UVAT, GDT and SDT. DaVAT is conceived not as an additional burden but rather as a shift of taxation, as the rate of the old consumption taxes can decrease proportionally to the increase of GDT. DaVAT is also designed in such a way that the erosion of tax revenues, when pollutant revenues would be offset by the extension of the tax to all goods and services and by the possibility to gradually re-increase the UVAT rate when the number of highly-polluting products decreases. To reduce the variance of the LCA results used for this purpose, the DaVAT system should use common databases, apply the same inventory, characterization, normalization and weighting methods, as well as refer to the same impact categories and the same cut-off rules. LCA as a whole can stay as it is, but for use in DaVAT specific impact categories (e.g. climate change/assessment based on previous studies has been made of the costs of implementation, maintenance, administration and compliance of DaVAT, as well as of the risks of fraud, price changes and acceptability of the proposal. The presentation shall briefly outline the results of this assessment.

Towards global guidance on LCIA of mineral resource use - outcomes from the UN Environment Life Cycle Initiative task force T. Sonderегger, ETH Zurich; M. Berger, Technische Universitaet Berlin / Chair of Sustainable Engineering - Office Z1; R.A. Alvarenga, Ghent University / Department of Sustainable Organic Chemistry and Technology; V. Bach, Technische Universitat Berlin / Chair of Sustainable Engineering; A. Cimprich, University of Waterloo; J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology; R. Frischknecht, trezee Ltd.; J. Guineau, University of Leiden / Institute of Environmental Sciences; C. Helbig, University of Augsburg; O. Jolliet, University of Michigan; M. MOTOSHITA, National Institute of Advanced Industrial Science and Technology; C. Norreby, Monash University / Chair of Sustainable Engineering; L. Tikana, DKI Copper Alliance / Life Cycle; A. Valero, Universidad de Zaragoza; M. Vieira, PRe Sustainability; S. Young, University of Waterloo; J. Zeman, TU Dresden; R. A. Alvarenga, Ghent University; M. Blosi, CNR; D. Gardini, CNR ISTEC; A. Costa, CNR Nano-silicon dioxide (TiO_2) and nano-silver (Ag) are among the materials most investigated for their technological importance and consequent interest in terms of their environment, health and safety (EHS) issues. In particular these particles cause alert for their capacity to generate, transport and release potentially toxicants such as metal ions and reactive oxygen species that can induce several negative effects, responsible for cytotoxicity. In this study we investigated silica coating as technique for control two recognised toxicity drivers for nano TiO_2 and Ag that are the exogenous production of ROS and the Ag\^+Ag total distribution. We evaluated the effect that silica coating had on physicochemical properties (size, shape, and zeta potential) of both Ag and TiO_2 and on their absorption, desorption and toxicological performances. We first demonstrated that both at colloidal and dried state a matrix of SiO_2 surrounding TiO_2 and Ag nanoparticles was formed, even by simply playing with colloidal attraction between the two hetero-phases. The presence of silica coating seems to have two important effects for the control of ROS and Ag\^+ toxicants, representing a safe by molecular design solution for the control of nanoactivity. 1) Silica acts as dispersing/diluting matrix for decreasing the production of ROS, but improving the photocatalytic performances of pristine sample; 2) Silica act as reservoir for Ag\^+ ions, decreasing the amount of immediately available fraction and so improving the range of concentration where the sample shows antibacterial properties despite to negligible cytotoxicity.

Framework for the optimal design of sustainable chemical processes A. Gonzalez Garay, R. Calvo-Serrano, G. Guillen Gosalvez, Imperial College London / Chemical Engineering Given its natural link between fundamental science, engineering and industrial practice, the chemical industry plays a key role in meeting the challenges of sustainable development. In particular, the use of computer aided tools for the generation of sustainable processes is essential to facilitate the transition towards a more sustainable chemical industry. In this work, we present a framework that incorporates sustainability principles in the design of chemical processes. The methodology proposed uses life cycle assessment to assess the sustainability of the processes; surrogate modeling and objective-reduction techniques to enhance the optimization of the processes; and data envelopment analysis (DEA) as multi-criteria analysis tool. The use of DEA facilitates the post-optimal analysis of the Pareto front by filtering and ranking the optimal designs that conform the Pareto frontier without the need to define explicit weights. In addition, DEA provides improvement targets for suboptimal alternatives that if attained would make them optimal designs.

A decision framework for substances of very high concern at the interface of chemicals, products and waste P. Wassenaar, National Institute for Public Health and the Environment (RIVM); P.G. Zweers, J.K. Verhoeven, National Institute for Public Health and the Environment RIVM; J. Spijker, RIVM; R.J. Luit, J.H. Ganzeveld, National Institute for Public Health and the Environment RIVM; M. Janssen, Nat. Inst. Publ. Health Environ. Centre for Safety of Substances and Products; L.C. van Leeuwen, C.W. Bodar, National Institute for Public Health and the Environment RIVM. Reuse and recycling of products are key elements towards a sustainable and circular economy. Besides the circular economy policy, a non-toxic environment is being pursued as well. Care should be given to the reuse and recycling of waste streams containing substances of very high concern (SVHC). Ideally, the presence of SVHCs in the design and production phase should be prevented by applying Safe-by-Design alternatives. However, we have to realize that we are still in an era in which we are faced with numerous (legacy) SVHCs in waste streams. For these waste streams, safe ‘end-of-life’ solutions have to be found in order to stimulate the circular economy and safeguard a non-toxic environment. With this study, we develop a decision framework to decide how waste streams with legacy SVHCs should be managed. The framework is specifically developed for the licensing process and provides guidance to license applicants and license authorities in the Netherlands. By following the framework, it will indicate whether the recycling of a specific waste stream into a specific end-product can be considered as acceptable with respect to the SVHC content. In principle, the use of this framework consists of three steps: 1) identification of SVHCs in the waste stream; 2) a basic decision scheme in order to decide whether a more elaborate risk analysis is necessary or whether the risks can be considered as acceptable; and 3) a risk analysis. Within the risk analysis, the acceptability of recycling will be assessed by weighing various aspects, including: availability and feasibility of SVHC removal possibilities, exceedance of SVHC concentration limit values, potential SVHC exposure of man and the environment, and the traceability of the material stream (including SVHC) during the whole life cycle. This framework is a first step to improve and warrant safe and sustainable recycling of waste streams. Future adjustments of this framework will be required in upcoming years based on practical experiences of
licensing authorities. Furthermore, it is advised to develop a broader decision scheme that besides SVHCs also considers and weighs other risk and benefit factors of recycling, like the risk of pathogens and medicine residues and the benefits with respect to sustainability (e.g. carbon footprint). Such a development will further stimulate the transition towards a safe and sustainable economy.

323 Emissions of PFAFs and alternatives from the durable water repellence layer (DWR) of textiles during use
Ly Veen, Institute for Environmental Studies (IVM) VU University Amsterdam / Chemistry and Biology; A. Hanning, Swerea IVF AB; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); J. de Boer, Vrije Universiteit Amsterdam Department Environment & Health / Environmental and Health; J. Weiss, Stockholm University, ACES / Department of Aquatic Sciences and Assessment; P. Leonards, VU University, Institute for Environmental Studies / Department of Environment and Health
In the durable water repellence (DWR) layer of textiles of outdoor clothing, PFAFs have been used because their perfluoroalkyl chains have the ability to repel liquids of a wide range of polarities (e.g. oleophobic and hydrophobic), and their low surface energy. Since long-chain PFAFs are being phased out for their negative environmental impact, industry has started to use alternative chemicals to provide the DWR in outdoor clothing. Within the SUPPES (Substitution in Practice of Prioritized Fluorinated Chemicals to Eliminate Diffuse Sources) project alternative substances in use are assessed in comparison with the long–chain PFAFs. As part of the SUPPES project we perform chemical alternative assessment including application hazards, exposure and life-cycle assessment studies. One of the studies focuses on the emissions of PFAFs from outdoor clothing vs. emissions of alternative DWR chemicals such as short–chain PFAFs (e.g. C4, C6) and silicones. We study the emissions using different emission scenarios which are based on real–life situations such as leaching to rain water, emission to air, weathering and washing and tumble drying. Within the SUPPES project different types of formulations, PFAS-based as well as silicon-based, have been applied to two different types of textiles, i.e. polyamide (PA) and polyester (PES). After testing the water repellence properties, a selection of four PFAS-based textiles and three silicon-based textiles have been used for assessing the emission of PFAFs and silicones. For chemical alternative assessments it is highly important to include proper application tests in combination with experimental emission exposure scenarios. This information will provide valuable information to aid selection of safer alternatives. The emissions of chemicals out of the DWR-treated textiles are not only depending on the type of DWR, but also on the type of textile used. Weather conditions, like sunlight, high temperature, or humidity can have a strong effect on the emissions of PFAFs and silicones. As part of the SUPPES project we have conducted emission scenarios which are based on a number of different soaking scenarios which are based on experimental emission exposure scenarios. This information will provide valuable information to aid selection of safer alternatives. The emissions of chemicals out of the DWR-treated textiles are not only depending on the type of DWR, but also on the type of textile used. Weather conditions, like sunlight, high temperature, or humidity can have a strong effect on the emissions of PFAFs and silicones.

324 Chemicals in plastic packaging: Prioritization of hazardous substances
K. Groh, Food Packaging Forum Foundation; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; B. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences; B. Geueke, Food Packaging Forum Foundation; A. Lennquist, Chemsec; H. Leslie, VU University Amsterdam / Environmental & Health; L. Martens, Food Packaging Forum Foundation; I. presses for nanomaterials. The proposed framework embraces the SbD concept proposed by NANOReg initiative, which uses the Super Tool Guide innovation model as backbone to incorporate SbD in structured innovation management processes for nanomaterials. Six steps build up the framework: (a) state–of–the–art assessment, (b) initial formulation, (c) screening hazard assessment (based on CLP self–classification approach for mixtures), (d) advanced hazard assessment (based on the development of an Intelligent Testing Strategy (ITS)), (e) safety assessment (including the definition of Risk Management Measures), and (f) sustainability assessment (where environmental, social, economic and technical criteria are integrated to compare new to conventional products). The framework is focused on application and post–application stages, while the manufacturing stage cannot be included until the industrial scale–up has been finalized. The SbD framework is currently being applied to NANORESTART advanced nano–based formulations for controlled cleaning and surface protection and consolidation. A specific ITS has been defined, including three bio–based toxicological endpoints: (i) aquatic toxicity, (ii) a set of tests for cytotoxicity, DNA–damage and mutagenicity. Moreover, specific leaching test protocols are being applied to investigate medium and long–term behaviour of products in post–application stages. The results of the framework application to the most promising formulations will be presented and discussed in detail.

Recent developments in environmental risk assessment for pollinators
325 A Safe by Design framework to support the development of sustainable nano–enabled products for the restoration of works of art
E. Giubbiato, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; E. Semenzin, Ca Foscari University of Venice / Department of Environmental Sciences Informatics and Statistics; E. Badetti, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; M. Picone, D. Hristozov, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; A. Brunelli, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; M. Bazzarelli, A. Rotondi, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; M. D. Bazzarelli, A. Rotondi, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics
Innovative nano–enabled products can overcome some of the traditional restoration techniques, especially in the case of complex and unstable materials used in contemporary artworks. However, nanomaterials have been demonstrated to be potentially hazardous to both humans and the environment. Thus, their application for the conservation of cultural heritage requires a proper assessment and management of potential risks. A Safe by Design (SbD) approach can support the early identification and management of uncertainties and risks during an innovation process and allows for the modification of a product design to avoid undesired properties. Within the EU H2020 “NANORESTART” project, a stepwise SbD framework for the sustainability assessment of nano–based products for restoration has been proposed, taking into account the current EU legislative context as well as the specific features of the innovation process in the restoration field. The proposed framework embraces the SbD concept proposed by NANOReg initiative, which uses the Super Tool Guide innovation model as backbone to incorporate SbD in structured innovation management processes for nanomaterials. Six steps build up the framework: (a) state–of–the–art assessment, (b) initial formulation, (c) screening hazard assessment (based on CLP self–classification approach for mixtures), (d) advanced hazard assessment (based on the development of an Intelligent Testing Strategy (ITS)), (e) safety assessment (including the definition of Risk Management Measures), and (f) sustainability assessment (where environmental, social, economic and technical criteria are integrated to compare new to conventional products). The framework is focused on application and post–application stages, while the manufacturing stage cannot be included until the industrial scale–up has been finalized. The SbD framework is currently being applied to NANORESTART advanced nano–based formulations for controlled cleaning and surface protection and consolidation. A specific ITS has been defined, including three bio–based toxicological endpoints: (i) aquatic toxicity, (ii) a set of tests for cytotoxicity, DNA–damage and mutagenicity. Moreover, specific leaching test protocols are being applied to investigate medium and long–term behaviour of products in post–application stages. The results of the framework application to the most promising formulations will be presented and discussed in detail.

Recent developments in environmental risk assessment for pollinators
326 Pollinating on the Margins: The confluence of Modern Agriculture and A
Z. Browning, Brownings Honey Co., Inc.
In the USA, beekeeping is a hobby, a sideline business, and commercial enterprise. Pollinating our backyard gardens, and local communities is made possible by backyard beekeepers with one hive or more. Beekeepers who aspire to increase their honey production, and crop pollination may have hundreds of hives serving not just their local communities, but their state or regions of the country renting their hives to pollinate specialty crops. Commercial beekeepers migrate with their tens of thousands of colonies to pollinate the nation’s food supply. Once commercial beekeepers have pollinated the majority of specialty crops they head to summer forage areas for a honey crop. The areas of conflict for bees in agriculture emerge the urban backyard garden to the almond orchards of California. Pest and pathogens of honey bees are real challenges regardless of location. Habitat loss and pesticide exposure to bees, are greater variables, but no matter what general shared land use is considered for bee hives there are potential conflicts. In each and every case, there are also opportunities to work together with partners and stakeholders for mutually beneficial outcomes. Whether it is water issues, soil quality, or the use issue of non–organic pesticides, there is a need for new measures, pesticide manufacturers must address how the end user interprets the directions for use, and the cultural practices of the products. Regulatory agencies must acknowledge the pesticide end user’s cultural practices of tank mixing pesticides, of fungicide and herbicide impacts upon pollinators, and to combine their agency efforts to protect the entire farm, not just each single crop from each single pest. Sustainable land management strategies to reduce food production or protection of human and animal health from disease vectors must be coordinated to ensure profitable production outputs for all stakeholders. Beekeepers can assist in the development of
scientifically supported risk assessment through participation in research development. Beekeepers know bees; researchers know research protocols. To understand how honey bees function under migratory beekeeping and crop field conditions beekeepers need to be part of designing the risk assessment research. Beekeepers, no matter the level of beekeeping or number of hives, are eager to be included in research that will help alleviate the risks to honey bees, and native pollinators. Involving beekeepers in risk assessment and research design is key to ensuring the research process and results truly reflect the real-world of beekeepers and honey bees. In some ideal world beekeepers would be respected for the ecosystem service their honey bees provide to farmers. Beekeeper and farmer would understand their symbiosis in connection with the health of the crop, and the success of the crop’s yield. Both would work to ensure a healthy crop and healthy honey bees. Pollination of all crops. One begets the other; each supporting each other; beekeeper and farmer, honey bee and crop (personal examples). As such all stakeholders who rely on honey bees and native pollinators to maintain a healthy ecosystem would balance competing interests to ensure pollinators have clean, plentiful, and diverse forage, pollinators are healthy to provide appropriate pollination services to the ecosystem, and land management is facilitated to reduce soil erosion, protect water, and reduce the threat of disease vectors. (share Bee and Butterfly Fund programs as results)

327 A new multi-dimensional method for evidence synthesis and weighting in bee risk assessment
A.A. Szentes, D. Auteri, Ecotoxicology; R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit

In recent years, neonicotinoids substances have often been in the spotlight, particularly due to their effects on bees. Reporting of highly contradictory results catalysed much attention from the scientific community. The great amount of available studies requests approaches able to ensure an effective integration of the available data. For this purpose, EFSA has developed a novel approach for the most recent conclusions on imidacloprid, clothianidin, and thiamethoxam. Risk due to exposure of bees from residues in pollen and nectar of treated crops is used here as a case study to illustrate the methodology. Oral exposure was estimated by combining data on residue levels in pollen and nectar and estimation of bee food consumption. Together with exposure data, higher tier effect data were the core of the weight of evidence exercise. Each endpoint was identified by four dimensions: (I) the magnitude of the observed deviation from the control, (II) the reliability, (III) the level of exposure in the experiment, and (IV) the length of the exposure. In order to visually illustrate these four dimensions of the endpoints and in order to help the interpretation of each ‘line of evidence’, a tailored graphical representation was developed. The relevance of each line of evidence was established a priori, based on the relationship with the specific protection goals (SPGs). Integration of the lines of evidence followed a stepwise procedure, giving priority to the higher classes of relevance. Single risk assessment results are beyond the scope of this platform, which aims at communicating the features of this new approach. This was, to our knowledge, the first systematic assessment on such a large body of evidence for this specific topic. The exercise combined systematic reviews and weight or evidence, sharing many aspects with meta-analysis techniques. The approach used in this assessment addressed some issues that commonly undermine the reliability of meta-analysis such as the so-called ‘file-drawer’ problem. Overall, the presented approach ensured significantly more transparency than a fully qualitative expert judgment-driven assessment, but still allowed considering several dimensions in a quantitative way. It is envisaging simplifying the assessment by using fully quantitative measurements that, at present stage, are hardly capable of retaining important qualitative information.

328 Pesticide Exposure Assessment Paradigm for Bumble Bees
A. Ippolito, J. van der Steen, Alveus AB Consultancy; C. Cutler, Dalhousie University / Faculty of Agriculture; D. Goulson, School of Life Sciences, University of Sussex; J. van der Steen - University of São Carlos UFSCar Araras / Ciências Biológica Departamento de Estudos de Insetos Sociais; R. Cornelio Ferreira Nocelli, Universidade Federal de São Carlos UFSCar Araras / Ciências Biológica Departamento de Ciências da Natureza Matemática e Educação; O. Malaspina, UNESP Universidade Estadual Paulista Júlio de Mesquita Filho / Departamento De Biologia, Centro de Estudos de Insetos Sociais

Brazilian bees are considered the most threatened bee species due to habitat loss, pesticides, and climate change. The Brazilian fauna, species from the same genus are recognized as effective pollinator of important crops like coffee, soybean, and cotton. The species have been identified. It is concluded that there are significant gaps in current knowledge for bumble bee species on both realistic levels for some key exposure routes and cumulative exposure that are not accounted for in the currentApis risk assessment protocols.

329 Industry research and approaches to improve the bee risk assessment scheme in Europe
E. Pilling, Dow Agrosciences / REGulatory Sciences; M. Miles, Bayer CropScience UK / Environmental Safety; A. Alik, Dow Agrosciences / Risk Management; J.C. Becker, New York State Dept. of Environmental Conservation / Biology; N. Roulston, Syngenta Ltd / Environmental Safety; A. Dinter, Chemnitzo Deutschland GmbH & Co. KG / Global Regulatory Sciences; A. Sharples, FMC Agricultural Solutions; G. Weyman, ADAMA; L. Oger, ECPCA

The crop protection industry recognizes the need to review the bee pollinator risk assessment based on scientific progress. However, the draft EFSA Bee Guidance Document is not a realistically feasible way forward. It is based on extremely conservative assumptions, its study requirements lack clarity and are not workable and guidelines for a number of studies are unavailable or not validated. Industry therefore believes that a revision of the assessment scheme for use by regulatory authorities is needed. Building on an analysis of the proposed developments in the EFSA Bee Guidance Document, we suggest proactive and practical approaches based on analysis of existing data generated thus far on honeybees Using the existing laboratory chronic toxicity and field exposure data, a draft paradigm for pollution focus on early toxicity and higher tier testing methodology. In its present over-conservative form, the EFSA guidance will make it difficult to regulate any new or existing insecticides, as well as many herbicides and fungicides. Industry believes that further work and significant revision are required to build a pragmatic, applicable and consistent guidance document within the regulatory framework and has invested much time and money in developing a practical alternative based on the same science.

330 Standardization of an in vitro larval rearing method for stingless bee species Melipona scutellaris for use in toxicological bioassay studies.
A.S. Dorigo, Universidade Estadual Paulista Júlio de Mesquita Filho Unesp Río Claro / Laboratory chronic toxicity and field exposure data, A. Rosa-Fontana, Unesp - Institute of Biology / Departamento De Biologia, Centro de Estudos de Insetos Sociais; R. Cornelio Ferreira Nocelli, Universidade Federal de São Carlos UFSCar Araras / Ciências Biológica Departamento de Ciências da Natureza Matemática e Educação; O. Malaspina, UNESP Universidade Estadual Paulista Júlio de Mesquita Filho / Departamento De Biologia, Centro de Estudos de Insetos Sociais

The crop protection industry recognizes the need to review the bee pollinator risk assessment based on scientific progress. However, the draft EFSA Bee Guidance Document is not a realistically feasible way forward. It is based on extremely conservative assumptions, its study requirements lack clarity and are not workable and guidelines for a number of studies are unavailable or not validated. Industry therefore believes that a revision of the assessment scheme for use by regulatory authorities is needed. Building on an analysis of the proposed developments in the EFSA Bee Guidance Document, we suggest proactive and practical approaches based on analysis of existing data generated thus far on honeybees Using the existing laboratory chronic toxicity and field exposure data, a draft paradigm for pollution focus on early toxicity and higher tier testing methodology. In its present over-conservative form, the EFSA guidance will make it difficult to regulate any new or existing insecticides, as well as many herbicides and fungicides. Industry believes that further work and significant revision are required to build a pragmatic, applicable and consistent guidance document within the regulatory framework and has invested much time and money in developing a practical alternative based on the same science.
the progress of the experiments, increasing from 67.1% in the first to 87.8% in the latter, and the morphometric analyses indicated newly emerged workers in vitro with similar sizes to in vivo. The in vitro rearing method described showed a satisfactory survival rate, as well as produced newly emerged workers with similar to those from natural conditions, allowing its use in toxicity tests.

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Poster spotlight: TU038, TU048, TU052
Understanding human and environmental exposure to chemicals in urban systems

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Consumption of products - a proxy for changes in chemical flows in urban areas and to the environment?

E. Undeman, D. Bolinius, Stockholm University / Baltic Sea Centre; A. Sobek, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES; M. Löf, Stockholm University / Baltic Sea Centre

Is the threat posed to the environment by harmful chemicals increasing or decreasing? Due to the extremely large number of chemicals and variety of adverse effects, it is challenging to develop indicators for the success of our management of chemical emissions. Indicators for efficiency of chemicals management can be based on a) information on production, trade and use of chemicals, b) emissions, c) concentrations in humans and the environment and c) human and wild-life health, with data on the latter being most relevant, but also difficult and/or expensive to produce for a wide range of chemicals. In this study, we use estimated consumption of products as point of departure to analyze time trends in use and emissions of chemical substances in the urban society and ultimately in the environment. Data on trade of manufactured products available in Eurostat was combined with chemical composition of products and materials compiled in the Commodity Guide hosted by the Swedish Chemicals Agency. The total mass of manufactured products in the northern Europe decreased slightly between 2005 and 2014. Despite this decline, ca 680 substances with significantly positive time trends due to increasing consumption of many products in which they are likely to be present were identified. We conclude, however, that substantially more data on chemical content of products is needed to successfully use consumption of products as a proxy for changes in chemical flows.

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High-throughput assessment of use-phase exposures to chemicals in building materials

L. Huang, University of Michigan / Dept of Environmental Health Sciences; V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; O. Jolliet, University of Michigan

Building materials have important contribution to the chemical exposures of the US population. The NHANES data have shown that the blood levels of brominated flame retardants and phthalate plasticizers, tend to be higher in children. The present study thus aims to develop a high-throughput method to determine exposures to chemicals in building materials, which mainly happen during the use phase but are often not considered in traditional LCA. The assessment framework calculates the product intake fraction metric, PiF, to assess consumer exposures during product use, i.e the fraction of a chemical in product that is cumulatively taken in by the users. Based on the building materials Pharos database, 22 product categories for building materials and 218 chemicals were identified. We focus here on 632 unique chemical-product combinations, and assess doses based on PHAROS chemical content data. Chemical emissions from building materials are mainly determined by Dm (diffusion coefficient in building material) and Kma (material-air partition coefficient). Two simple emission models were developed for two types of behaviors: D-limited and K-limited. Use-phase exposures by inhalation, dermal contact, gaseous dermal uptake and dust ingestions were calculated using the PiF metric. Results showed that for SVOCs, the total PiF can be dominated by any of the four exposure pathways. Generally, the chemical-product combinations with low total PiFs are dominated by dust ingestion exposures, while the ones with high total PiFs are dominated by dermal contact exposures. For VOCs, inhalation PiF always dominates the total PiF. Generally, the PiFs of VOCs are similar between 50 days and 15 years, but the daily intake doses during 50 days are much higher than those during the entire 15-year use phase. In contrast, for SVOCs, the emissions and PiFs gradually increase when the duration of use is extended from 50 days to 15 years, but the daily intake doses remain similar over time. The total intake dose, which combine the total PiFs and chemical content in building product, can range from 100 to 10^8 μg/kg-d for children. This study demonstrates the approach of high-throughput screening of use-phase exposures for chemicals in building products, which can be further integrated into characterization factors and help improve LCA and Chemical Alternatives Assessment (CAA) of consumer products.

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OPEs - Where do they come from, where do they go? A case study from Toronto, Canada

T.F. Rodgers, University of Toronto / Chemical Engineering and Applied Chemistry; Y. Adjei-Kyereme, University of Toronto / Earth Sciences; C. Yang, University of Toronto / Department of Earth Sciences; S. Harris, Cancer Care Ontario, University of Toronto / Population Health and Prevention, Prevention and Cancer Control; L. Jantunen, Environment and Climate Change Canada; M.L. Diamant, University of Toronto / Department of Earth Sciences

Organophosphate Esters (OPEs) are used in a wide range of consumer products and building materials resulting in their ubiquitous presence in the indoor and outdoor environment. Concentrations of OPEs in indoor air can be relatively high, in the range of 10^3 ng/m^3 in air. Concentrations are also relatively high in urban media (e.g., low µg/L levels in urban surface waters) and OPEs are commonly found in remote Arctic air. We hypothesize that elevated levels of OPEs in the indoor environment are a source to the outdoor urban environment and then to surrounding regions. To test this hypothesis, we estimated emissions of OPEs to indoor air followed by release to outdoor air, and then compared these “bottom-up” emission estimates to “top-down” estimated aggregate emissions to outdoor urban air. We used the approach of “inverse modelling”, whereby emissions are back-calculated from measured air concentration. “Bottom up” emissions were estimated using the Multimedia Indoor Model that has been used to calculate emissions of PBDEs and PCBs to indoor air, based on indoor air concentrations measured in a study of 51 homes in Ontario, Canada. “Top-down” emissions were calculated using the Multimedia Urban Model based on measured Toronto outdoor air concentrations, main receptors for these molecules. Pharmaceuticals can be related to the use of CP and TPhP, respectively. The emissions factors of OPEs from indoor air to outdoor air estimated in this study were within the range estimated by Liagkouridis et al (2017) for bulk emissions to indoor air. These “bottom up” emissions from indoors to outdoors estimated here were one to two orders of magnitude lower than the “top-down” estimations, which could be caused by higher emissions from commercial buildings, or through direct emissions of OPEs to outdoor air, such as from insulation. It is clear that elevated indoor and outdoor air concentrations of OPEs are due to emissions from the many products and materials to which they are added. When aggregated over a city scale, indoor air emissions vented to outdoor air were lower, but within one to two orders of magnitude of aggregate air emissions back-calcultated from outdoor concentrations. Ozone formation rate is governed by partitioning between air and high sorptive-capacity materials such as PUF in upholstered furniture and carpets and ventilation rate, as with other SVOCs. Outdoors, fate is governed by air advection and water movement, because of the high solubility of OPEs.

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Drivers of pharmaceutical exposure in urban river systems

E. E. Burns, University of York / Chemistry; L. Carter, University of York / Environment Department; J. Thomas-Oates, University of York / Chemistry Department; A. Boxall, University of York / Environment Department

Pharmaceuticals are heavily used by society and urban environments are one of the main receptors for these molecules. Pharmaceuticals can be released to the urban environment from multiple point sources within a city and can then dissipate as they move away from the point of release. Spatially referenced hydrological models such as LF2000-WQX, GREAT-ER and PhATE have been developed to address this issue. Many pharmaceutical monitoring studies have indicated that temporally significant fluctuations exist in rivers receiving urban wastewater. Currently, spatial models typically overlook the temporal aspect of pharmaceutical concentrations by predicting an annual average concentration usually based on conservative flow estimates. The relevance of these estimates in comparison to real world temporal variations in pharmaceutical exposure has yet to be determined. In this study we attempt to quantify and understand the drivers behind spatiotemporal fluctuations in the concentrations of pharmaceuticals in a city system. Monitoring data for 33 pharmaceuticals were obtained monthly at 11 sites in two rivers that run through the City of York, UK. This data was compared with local monthly prescription, tourism and flow data. In the smaller River Foss, a strong relationship was found between measured concentrations and prescription amounts divided by flow. This trend was not replicated in the larger more urbanised River Ouse. Analysis of pharmaceutical loads indicate that seasonal differences exist in the Ouse, but not in the Foss. Seasonal variability in WWTP removal efficiency is expected to be a factor. In-stream losses of up to 75% were found in the River Foss during summer months and all pharmaceuticals studied followed a sinuousoidal loss pattern through time. Significant losses were not identified in the River Ouse. Finally a risk assessment indicated that risk quotient ratios can vary over 3 orders of magnitude (paracetamol) throughout the year and the highest peaks for naproxen, ibuprofen and loradatine, are temporally transient. Identification of exposure drivers at this unparalleled spatiotemporal scale provides important information that may help improve the accuracy of exposure models and help ensure risks are not overlooked.

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Past vs. recent emissions of PCBs from the city of Brescia (Italy): coupling monitoring data with a multimedia fate model to investigate PCB regional fate

E. Terzaudi, University of Insubria (Como) / Department of Science and High Technology, Como; M. Morselli, University of Insubria / Department of Science
and High Technology; G. Raspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; A. Di Guardo, University of Insubria / Department of Science and High Technology

Different monitoring campaigns showed higher PCB concentrations in the air of cities compared to rural areas, indicating the presence of ongoing emission sources in urban locations. This is the result of both the past usage of these chemicals in building materials and electrical equipment from which they can volatilize and/or migrate to the air from e-waste contaminated soils. It was estimated that cities could emit up to about 1 tons/year of PCBs (Gasic et al., 2009; Diamond et al., 2010), which can be transported to rural sites, posing adverse effects to human and ecosystems. The city of Brescia, is characterized by the presence of a factory (Caffaro s.p.a.) that produced PCBs between 1930-1984 and its surrounding areas were found to be heavily contaminated with high concentrations in soil at mg/kg levels. For this reason, about 200 ha of this city were declared National Priority Site for remediation (SIN Brescia Caffaro) by the Italian authorities, representing an important secondary source of PCBs to the atmosphere.

The aim of the present study was to investigate the potential of the Brescia city in driving the PCB contamination at regional scale up to 100 km from the point source and the current effects on air concentrations, combining measured data and a multimedia mass balance model. Different sampling campaigns were organized to collect samples of soil and leaves along four 100 km transects that ran in NW, NE, SW and SE directions considering the production plant as starting point. In each sample, the following PCB congeners were determined: PCB 28, PCB 52, PCB 101, PCB 153, PCB 138, PCB 180 and PCB 209. The results were analysed to understand the relative contribution of far-field and near-field emission routes with distance from the point source. Furthermore, a spatially resolved version of a dynamic air-vegetation-soil model (SoilPlusVeg model) was used to predict a temporal emission profile from the city, verify if an emission source strength previously predicted for this city justifies soil concentrations in the surrounding area and, evaluate the importance of other sources and processes involved in the contamination. This study shows how a combined modelling approach could be used to unravel the past and recent impact of PCB emissions from a source on the surrounding areas at a regional scale.

337 Using a Dynamic Aggregate Exposure Model to Identify Far- and Near-Field Contributions to Human PCB Exposure through Time
L. Li; University of Toronto at Scarborough / Department of Environmental Sciences; J.A. Arnott, ARC Arnott Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; F. Wania, University of Toronto at Scarborough / Physical and Environmental Sciences.

Humans are exposed to polychlorinated biphenyls (PCBs) through “far-field” sources from the ingestion of contaminated food from aquatic and terrestrial environments and “near-field” sources from building materials in indoor environments. Earlier models that consider far-field exposure only tend to underestimate historical body burdens. In this presentation, we will explore the time-dependence of the relative contribution of far- and near-field emissions on aggregate human exposure to PCBs, to explain the discrepancy between previous far-field only model predictions and observations. We develop a mechanistic model that incorporates dynamic substance flow analysis, in-door and outdoor fate, bioaccumulation and human toxicokinetic modeling, enabling a dynamic and mechanistic description of the complicated continuum from annual industrially processed amount of PCBs to the human uptake rate. The model is applied to simulate the time-variant exposure of Swedish women to PCB-28 and PCB-153 from 1930 to 2030. In terms of a female’s lifetime longitudinal exposure, our modeling indicates that route-specific contributions to aggregate human exposure change with age and differ among birth cohorts: Near-field exposures are notable during childhood and teenage years, as well as for female cohorts born earlier, when the indoor environment was more highly contaminated. In terms of the exposure of individuals of different ages at the same time (i.e., the cross-sectional age-exposure relationship), the dominance of far- or near-field routes differs little among ages, but is largely dependent on the time a cross section is “sampled”: Near-field routes dominate in the past (e.g., the year 1956) whereas far-field sources become predominant more recently (e.g., 1986 and 2016). This finding suggests that the dearth of PCB biomonitoring studies before 1990s has also contributed to the general belief that far-field sources dominate human PCB exposure. It further implies that there may also be a similar shift from a near-field dominance to a far-field dominance among a wide range of currently-used indoor chemicals, such as flame retardants. This work improves our understanding of the exposure dynamics, which would be beneficial for future pertinent management actions for exposure reduction and prevention.

Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (III)

338 Modelling of the environmental release of macro- and microplastics for seven different polymers
D. Wenger, Empa Swiss Federal Laboratories for Materials Science and Technology; B. Nowack, EMPA

Microplastic exposure is a burning topic in environmental research, but few large scale exposure studies have yet been performed in freshwaters. Assessing the emissions of plastic is possible using a life-cycle oriented approach, and permits to compare the flow magnitudes for different sources. With our ongoing study, we aim at providing large scale predictions of macroplastic and microplastic exposure in Europe through Probabilistic Material Flow Analysis (PMFA). The environmental flows of seven different commodity thermoplastics are estimated based on societal data. The polymers are chosen for their popularity of use and the frequency at which they are reported in the environment: low-density polyethylene (LDPE), high-density polyethylene, polypropylene (PP), polystyrene (PS), expanded polystyrene (EPS), polyvinyl chloride (PVC) and polyurethane terpolyethylene (PET). The probabilistic aspect of the PMFA framework permits one to account for the various uncertainty sources and give a quantitative estimate of the final confidence in the results. In a first step, the anthropogenic life cycle of these seven polymers is modelled, from production to end of life of a total of 35 product categories. Various trade flows are included, as well as the life cycle of textile applications. This enables us to present an accurate estimation of the European and Swiss polymer emissions to water. In a second step, every stage of the life cycle is analyzed and the voluntary or inadvertent emissions are assessed. The emission-specified pathways between the anthroposphere and the environment are described, and the resulting environmental flows are compared. Modelling the emission pathways between prime release and final discharge enables to pin-point the principal plastic pollution sources and the possibilities for pollution mitigation.

339 Modelling Microplastics in Rivers in the US
A. Koelmans, Wageningen University / Aquatic Ecology and Water Quality Management; C.M. Holmes, Waterborne Environmental Engineering.

In contrast, large scale predictions of macroplastic and microplastics (MPs; particles < 5 mm) is a topic of emerging concern and as such receives growing interest. Although measurement and monitoring data are indispensable, there also is a need for estimated concentrations to enable prospective assessments and to guide analysis of retrospective ecological analyses. Besseling et al (2017) provided the NanoDUFLOW model, a detailed MP aggregation-sedimentation model integrated in a hydrological and particle transport model. A much larger scale model potentially suitable to simulate MPs originating from WWTPs is the iSTREEM® model, which has been developed to estimate chemical concentration distributions for all rivers and streams of the USA receiving WWTP discharges. Here we merge these two riverine modeling worlds: NanoDUFLOW with iSTREEM for MPs, to simulate the reach of MPs from point source WWTPs and to assess export to the Great Lakes for a range of particle sizes. This combines the mechanistic realism of NanoDUFLOW, accounting for formation and settling of heteroaggregates, with the US well-established iSTREEM implementation. We modeled floating as well as non-buoyant MP, for diverse sizes, from 100 mm to 10 mm, a range that incorporates the theoretical parabolic size-settling relationship reported by Besseling et al (2017). Depth dependent in-stream first order removal rate constants simulated with NanoDUFLOW were combined with standard iSTREEM output (which was used to simulate the emission, transport and water column concentration distributions of MP) in an Excel-based post-processing phase, without modifying the iSTREEM model directly. Simulations were spatially explicit with MP concentrations being modeled for the Sandusky River watershed in Ohio (~3500 km²). Emitter capital inputs and population were used for each of the 20 WWTPs within the watershed. Modelling results show the effects of population density, MP size and density on riverine concentrations and export to Lake Erie. Buoyant as well as the smallest non-buoyant MP fractions can be transported over long distances, reaching receiving waters such as the Great Lakes. In contrast, larger non-buoyant MPs settle more locally in the vicinity of the WWTPs. Simulating depth-dependent removal as demonstrated here could be incorporated into the core iSTREEM code in order to efficiently process all US waterways impacted by WWTPs, as well as examining ultimate marine discharge proportions by particle size. 

340 The routes to uptake and bioaccumulation of nanoplastics in freshwater sediments
R. Cross, C. Liddle, University of Exeter; T.S. Galloway, University of Exeter / Biosciences

Plastic contamination of freshwater sediments is well documented, and whilst quantitative measurement of exposure in route to uptake in freshwater ecosystems is difficult due to low recoveries and the presence of nanoplastics in sediments are beyond current analytical capabilities, recent models predict plastics < 1000 nm in size will be effectively retained in freshwater sediments. Current debate considers whether micro and nanoplastics can be defined as persistent organic pollutants (POPs) in their own right. In order for such a classification, four criteria must be met, one of which is for a compound to be bioaccumulative. Nanoplastics do not adhere to the classical concept of molecular bioaccumulation in sediments by apheres. However, assessing their potential uptake and transfer through food chains can contribute towards the data required to inform decisions as to the suitability of classifying nanoplastics as POPs. This study provides initial insights to address this question in
an ecologically relevant system, using the freshwater aquatic worm Lumbriculus variegatus, representing an entry point for nanoplastics from abiotic compartments of sediments, into biota. The role of surface functionalisation of fluorocarbons dyed nano-polystere (50 µm) upon their uptake is systematically examined using a combination of techniques including a novel fluorescence assay and fluorescence microscopy. A series of exposure scenarios are used to test the efficacy of different routes of uptake into the worm. Associations of nanoplastics to the worms’ surface are examined in waterborne exposures, whilst dietary uptake is tested using nanoplastics associated with an algae food source. The accumulation of nanoplastics directly from contaminated sediments is also investigated, alongside the fate of these particles in sediments to assess the relationship between nanoplatic mobility and accumulation. Results indicate that pristine nanoplastics and nanoplastics containing attached sediment particles were taken up by worms and that dietary uptake of a nanoplastics associated algal food source, with carboxylated and amminated plastics experiencing greater uptake than non-functionalised particles. Sediments on the other hand, reduced the availability of these particles for uptake into the worms, potentially through strong associations of the nanoplastics to solid constituents of the sediment. Ongoing work addresses the potential for formation of an “ecocorna” to alter the bioaccessibility of nanoplastics for the worms. These results will also be presented during the platform presentation.

341 Life-history and biochemical responses of Chironomus riparius exposed to different sized microplastics
C. Silva, CESAM & University of Aveiro; J. Pestana, CESAM & University of Aveiro / Biology; C. Gravato, Faculty of Sciences, University of Lisbon / department of Biology & CESAM

Freshwater basins are an integral part of microplastics life-cycle, being a repository of plastic micro-debris. In fact, the levels found so far are similar to those found in marine environment and shoreline regions. The deposition and persistence of plastic micro-debris in sediments (lakeshores and riverbanks) makes them long-time available for benthic species. The objective of this study was to investigate developmental, and physiological effects induced by the presence of polyethylene microparticles (PE) in Chironomus riparius, due to its key-role in the freshwater ecosystem. For that partial life cycle tests using different sized polyethylene particles (PE 40–48 µm; PE 125 µm and PE 350 µm) allowed evaluation of effects on C. riparius larval growth and emergence patterns while acute exposures were used to assess effects in parameters related to neurotransmission (ACHÉ); antioxidant defences and biotransformation (CAT; GST total glutathione levels); oxidative damage (LPO); cellular energy allocation (CEA) and immune response (phenoloxidase). Exposure to PE 40–48 µm caused deleterious effects at lower concentrations in comparison with larger particles in several parameters: larval growth and development time of both male and female imagoes and on emergence rate. PE 40–48 µm were then selected to assess effects on physiological homeostasis. Acute exposures to PE 40–48 µm generated alterations in C. riparius larvae antioxidant and biotransformation enzymes activities (CAT, GST and total glutathione) and activation of immune response (induction of phenoloxidase). Larvae exposed to microplastics showed also a depletion in energy reserves. Our study highlights the potential deleterious effect of microplastics for aquatic invertebrate populations. Results will be discussed in terms of effects of different sized plastic particles on different levels of biological organization within freshwater invertebrates and on the needed and ongoing research aiming to address the long term and indirect effects of these particles for natural populations and ecosystem functioning.

342 The effects of rigid and flexible Polyvinyl chloride (PVC) microplastic particles on the transcriptome of Daphnia magna
B. Trotter, University of Bayreuth / Animal Ecology I; I. Schrank, J. Dummett, A. Weig, C. Laforsch, University of Bayreuth

Microplastics are ubiquitous in aquatic ecosystems, posing as a threat to biota of all trophic levels, as they have the potential to leach out incorporated additives, such as plasticizers, to the surrounding medium. Yet the question arises, if possible effects on biota are based on the polymer type alone, or if incorporated additives are responsible for the observed effects, as the insight desorb from the polymer matrix. With our transcriptome analysis, which was conducted via the use of a microarray, we showed that flexible PVC had a more severe effect that might be attributed to the leakage of DINP (Diisononyl phthalate) in comparison with these two different rigid microplastic particles. Therefore our results highlight, for the first time that differences in additive composition (absence or presence of a plasticizer) can lead to substantial differences in effects on aquatic species.

When ecotoxicology meets trophic ecology

343 Poster spotlight: TU149, TU150, TU151

344 Does stress propagate along aquatic food chains? An experimental approach with a tri-trophic brown food chain
E.L. Fernandes, University of Koblenz Landau; M. Bundscho, Swedish University of Agricultural Sciences / Department ofAquatic Sciences and Assessment; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences

Pollution is a major driver of ecosystem change resulting in alterations in food webs and food web interactions. Some pollutants such as systemic insecticides are taken up by terrestrial plants and may enter aquatic systems with plant parts such as leaves that are an important energy source in stream food webs. Thereby, food web interactions across the aquatic-terrestrial boundary may be affected through alterations in food quality. Here we studied the effects of a systemic insecticide, the neonicotinoid imidacloprid, and their potential propagation in a brown food chain. The model food chain consisted of imidacloprid contaminated terrestrial leaves (alder, Alnus glutinosus Gaertn.), aquatic meromictic invertebrate decomposers (Protonemura sp.) and predators (Isoperla sp.). Effects of imidacloprid on survival and growth of decomposers and its leaf processing were assessed in a microcosm setting. Therefore, decomposers fed on control or contaminated leaves for 3 days on the microcosms. Every 6 hours the number of dead individuals was recorded. Potential propagation of imidacloprid effects were assessed by transferring surviving decomposers to cages containing the predator. The cages were deployed in an unpolluted stream for 9 days after which predators’ growth was analysed. Imidacloprid concentrations increased within the contaminated microcosmos over time. The presence of imidacloprid in the water was associated with lower survival rates and leaf decomposition in contaminated microcosmos compared to the control. Furthermore, decomposer’s biomass and length decreased in the contaminated but not in the control microcosmos. Predators hunting decomposers from contaminated microcosmos decreased in body size compared to the control. Systemic insecticides in plant materials can be a relevant source of exposure for decomposers with consequences for their population dynamics and degradation rates. The impacts of imidacloprid on the associated ecosystem processes (reduced leaf decomposition). The effects can propagate through food chains and result in indirect effects in predators. Future studies should elucidate the spatiotemporal dynamics of exposure and uptake given that imidacloprid leaches from plant material and may influence downstream food webs directly and indirectly.

345 Accounting for trophic relationships in fish bioconcentration models applied as emergent-pollutants risk-assessment tools
h. baveco, Wageningen Environmental Management; J. Denner, Wageningen Environmental Research / FauwNor; S. Backhaus, Environmental Consulting; J. van Gils, DELTARES; C. Lindim, Stockholm University / SEAC; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team

In the context of the SOLUTIONS EU FP7 project, we applied non-steady state bioconcentration models to predict concentrations of organic compounds in fish. A foodweb perspective was taken, accounting for uptake from water as well as from food, and accounting for different trophic relationships for several fish species used for human consumption. The foodweb bioconcentration model will be applied for a large number of emerging pollutants and a large number of locations (around 25,000 sub-catchments in the major European catchments). Water concentrations at these locations are obtained from chemical fate modelling using the STREAM-EU model. As a case study, results for 24 WFD priority substances are presented here. Predicted concentrations will be input to human health risk assessment. The model also provides insight in how trophic relationships together with species and compound characteristics determine bioconcentration and thus ecotoxicological risk. The core of the foodweb model is a bioconcentration model for neutral and ionisable organic compounds (Arnott & Gobas 2004; Armitage et al. 2013) underlying each fish component. It calculates for given environmental conditions (pH and temperature) the uptake and elimination rates defining the one-compartment model of the internal concentration dynamics. The considered foodweb contains fish components with different trophic relationships, representing fish species used for human consumption with different body size and lipid content, chosen to represent extreme cases with respect to expected bioconcentration. Internal concentrations in phyto- and zooplankton are assumed to be in instantaneous equilibrium with water concentration. For 24 WFD priority substances concentration timeseries per sub-catchment from the STREAM-EU model were used as input to the foodweb bioconcentration model. Results were summarized in monthly and annual maximum and mean concentrations for all foodweb components in each sub-catchment and displayed in maps covering the
EU. From these results, e.g., median concentrations can be calculated per catch or over allcatchments. Concentrations in fish depend on local exposure pattern and differ per subcatchment. They also depend on trophic position in a compound-specific way: any of the three fish components can be worst-case. To indicate risk to human health, concentrations need to be related to standards of e.g., acceptable daily intake.

346 Model-based explorations of the variability in lake trout BAFs caused by physiology and trophic relationships

S. Buskaran, University of Toronto - Scarborough / Chemistry; J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; F. Wobeser, University of Toronto at Scarborough / Physical and Environmental Sciences

Because dietary uptake of fish is often a major vector of human exposure to persistent organic pollutants (POPs), much effort is directed towards a quantitative understanding of fish bioaccumulation with the help of mechanistic models. Such models require the input of the growth, feeding and respiration rates of a fish. However, often little consideration is given to the interdependency of these physiological parameters. Here, we calculate the bioaccumulation factor (BAF) of hypothetical POPs, with log Kow values ranging from 4.5 to 8.5, in lake trout (Salvelinus namaycush), with a food web bioaccumulation model that uses bioenergetic equations to ensure that the physiological parameters applied to a species are internally consistent (i.e. energetically balanced). Empirical growth rate and diets for lake trout, six Canadian lakes (Lake Slave Lake, Lake Ontario, Source Lake, Happy Isle Lake, Lake Opeongo, and Lake Memphremagog) are used to determine feeding rates. Respiration rates were derived based on the routine metabolic rates and the population specific activity coefficients (multipliers). When comparing differently sized lake trout within a lake, larger fish tend to have the highest BAF, because they allocate less energy towards growth than smaller fish and have higher activity levels. When comparing fish from different lakes, diet composition and prey energy density become important in determining BAF in addition to activity and the amount of total energy allocated to growth. Specifically, fast growing Lake Ontario lake trout, feeding on slow growing alewife, have higher BAFs; while slower growing small lake trout in Happy Isle and Source Lakes have low BAFs because they feed on invertebrates, which are low in the food chain. Moreover, very large trout in Great Slave Lake with higher energy requirements feeding on an energy rich diet have lower BAFs compared to the same sized trout in Lake Memphremagog eating less rich rainbow smelt.

347 Influence of an agriculture-associated toxicity gradient on a riparian predator-prey relationship in Romania

N. Graf, P. Dittrich, University of Koblenz Landau; M.H. Entling, University of Koblenz-Landau / Institute for Environmental Sciences; K. Frisch, M. Link, V.C. Schreiner, E. Szöcs, University of Koblenz Landau; R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences

Riparian areas in Central Romania are impacted by extensive agriculture, resulting in blow out of chemical pollutants into adjacent streams via fluxes of material and organisms. Agricultural land use related stressors can differentially alter arthropod communities in water and on land, resulting in complex response patterns of aquatic-terrestrial predator prey relationships. Therefore complex response patterns may arise in terrestrial predators feeding amongst others on aquatic prey. While agricultural landscapes in most European countries have been intensified, resulting in an increased co-occurrence of pesticide use, habitat degradation and excessive nutrient inputs, traditional low-intensity agriculture can still be found in Central Romania. We investigated the potential effects of land use related stressors including pesticides on aquatic-terrestrial predator-prey relationships using stable isotope analysis. We sampled spider communities and measured their intake of aquatic prey in 19 riparian areas around Cluj-Napoca, Romania. To investigate the spiders’ diet, aquatic and terrestrial prey organisms were caught. We collected the orbweaver Tetragenatha sp. and the ground-dwelling spider Pardosa sp. to analyse their stable carbon and nitrogen signals. Nutrient concentrations in the stream were slightly positively associated with the proportion of aquatic prey of Pardosa sp. This may be explained by nutrients in the streams increasing productivity of primary producers and in turn resulting in a larger biomass of emerging insects. The toxicity gradient was negatively related to the number of individuals of spiders and the number of species spiders. Although we found clear differences in the proportion of consumed aquatic prey of spiders, the proportion of it was not related to the toxicity gradient. Thus, potential effects of pesticides in the aquatic system did not affect the proportion of consumed aquatic prey organisms of riparian spiders. We found less individuals of Tetragenatha sp. when they consumed more aquatic prey. This might be due to an accumulation of toxicants in the spiders or a higher competition between the species due to resource shortage. Riparian spiders can be affected directly by agricultural land use but also indirectly via prey consumption. Changes in riparian spider communities and their diets are presumably driven by multiple stressors.

348 Migration effects on pollutants in eggs of Arctic-breeding geese

D.J. Hitchcock, University of Oslo; M.J. Loonen, University of Groningen / Arctic Center; N.A. Warner, NILU - Norwegian Institute for Air Research / Environmental Chemistry; D. Herzke, NILU - Norwegian Institute for Air Research / FRAM Centre Tromsø; I.M. Tombre, NINA - Norwegian Institute for Nature Research; P. Shimmings, BirdLife Norway; L.R. Griffin, WWT Caerlaverock Wetland Centre, . Vare, University Centre in Svalbard; T. Andersen, University of Oslo / Department of Biosciences; K. Borga, Department of Biosciences; University of Tromsø / Department of Biology.

Arctic breeding barnacle geese (Branta leucopsis) are a herbivorous species that migrate from the United Kingdom to the Arctic every summer to breed. Females utilise resources towards reproduction along the flyway, including distant resources (United Kingdom and Northern Norway) and local resources (Svalbard) relative to the breeding grounds. Depending on migration route, allocation of resources towards egg production may differ within a breeding goose population. Thus, different energy sources may also affect how pollutants are taken up and deposited to eggs, including those which are both protein and lipid soluble. In order to examine the effect of migration on pollutants in eggs, a field study was carried out during the breeding season of 2016. Eggs (N = 60) were collected at an island breeding colony in Svalbard and several hundred grams of vegetation (N = 15 samples) were collected at different sites along the geese’s flyway. Resightings of ringed geese also took place in Northern Norway. Egg and vegetation samples were analysed for stable isotope of carbon (δ13C) and nitrogen (δ15N), as well as pollutants including protein-associated poly- and perfluoroalkyl substances (PFAs), lipid soluble polychlorinated biphenyls, and hexachlorobenzene (PCBs and HCB). Stable isotope ratios in eggs could not be explained by POPs but emerged to originate from local prey associated with the flyway, while stable isotopes of nitrogen appeared to be fuelled by distant resources in United Kingdom and Northern Norway. When examining pollutants individually, there was no relationship found between stable isotopes and pollutant concentrations. However, when combining pollutants together as part of a multivariate analysis, it was found that egg laying date contributed to the variation in PFAS levels across eggs from different breeding colonies. For PCBs, Protein associated pollutants (PFASs) may be more influenced by migration strategy than lipid soluble contaminants (PCBs and HCB), due to protein stores being a more limiting energy source during migration than lipids. This knowledge furthers our understanding on how pollutants operate within Arctic terrestrial ecosystems, and the interaction between climate and pollutant bioaccumulation in highly seasonal environments.

349 Trophic Magnification of Persistent Organic Pollutants Within A Terrestrial Food-Web of An Avian Top Predator, the Cooper's Hawk (Accipiter cooperii)

K. Borga, University of Tromsø / Department of Biology; K. Bring, SFU / Department of Biological Sciences; J.E. Elliott, Environment Canada / Science Technology Branch; F. Gobas, Simon Fraser University / Resource & Environmental Management; K. Drouillard, Great Lakes Institute for Environmental Research University of Windsor; D. Green, Simon Fraser University

Several types of legacy persistent organic pollutants (POPs), such as PCBs and DDEs, but not for PCBs. Protein associated pollutants (PFASs) may be more influenced by migration strategy than lipid soluble contaminants (PCBs and HCB), due to protein stores being a more limiting energy source during migration than lipids. This knowledge furthers our understanding on how pollutants operate within Arctic terrestrial ecosystems, and the interaction between climate and pollutant bioaccumulation in highly seasonal environments.

Integrated approaches in ecotoxicology: bridging the gap between experimental toxicology and mechanistic modelling

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Toxicokinetic-toxidynamic models as new tools for environmental risk assessment

S. Charles, University Lyon 1 / Laboratory of Biometry and Evolutionary Biology; V. Baudot, Université Lyon 1; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team

Today, the Environmental Risk Assessment (ERA) for chemicals is based on fitting standard dose–response (DR) models to quantitative data. Such data are usually collected from standard toxicity tests, from which the concentration leading to 50% lethality or effect (LC₅₀ or EC₅₀) is usually estimated at the end of the exposure. In this form of evaluation, the fact that endpoints are monitored over time is not fully exploited. Standard DR models do also assume that the exposure concentration remains constant during the experiment, what makes it difficult to extrapolate the results to more realistic exposure profiles, for example to effects under time-variable exposure profiles. To overcome this gap at the organism level, the use of the toxicokinetics-toxidynamics (TKTD) models is suggested, because TKTD models describe the effects of a substance by integrating the dynamics of exposure [1]. Indeed, TKTD models have many advantages in terms of mechanistic understanding of the chemical mode of action, of deriving time-independent parameters, of interpreting time-varying exposure and of making predictions for untested and time-variable exposure. Another advantage of TKTD models for ERA is that they make it possible to calculate any LC/EC₅₀, for arbitrary effect strength, x and any given exposure duration t. Nevertheless, being based on differential equations their mathematical complexity makes it necessary to numerically integrate the equations when fitting the model to data, so that in practice TKTD models are still not used, there are not enough data to allow us to use them and TKTD models for regulatory risk assessment without suffering any technicalities, the availability of a software environment for an easy handling of TKTD models would be of great value. That is the aim of the R package ‘mosr’ in its new version 3.0.0. [2]. In this presentation, we will give an overview of TKTD models with a focus on the General Unified Threshold model for Survival (GUTS) [3]. Handling GUTS models can sometimes be challenging and will be illustrated with one example dataset. Finally, the added-value of TKTD models for ERA will be discussed based on a number of different datasets.

351 Lethal and sublethal impacts of neonicotinoids and copper nano-particles on the energy budgets of an estuarine amphipod

E.B. Muller, University of California, Santa Barbara / Marine Science Institute; J. Couture, H.S. Lenihan, University of California Santa Barbara / Bren School of Environmental Science and Management; J. Means, University of California Santa Barbara; K. Tran, C. Vignardi, University of California Santa Barbara / Bren School of Environmental Science and Management; S. I. Deegan, University of California Santa Barbara

Estuaries are major recipients of run-off pesticides from agricultural and urban origin, including neonicotinoids and nano-based copper formulations. Neonicotinoids have rapidly become the most widely used insecticides globally, and have been implicated for harming pollinators and non-target species at levels below existing US EPA toxicity thresholds. With most research conducted on individuals rather than populations, we can lack data to allow us to use TKTD models for regulatory risk assessment without suffering any technicalities, the availability of a software environment for an easy handling of TKTD models would be of great value. That is the aim of the R package ‘mosr’ in its new version 3.0.0. In this presentation, we will give an overview of TKTD models with a focus on the General Unified Threshold model for Survival (GUTS) [3]. Handling GUTS models can sometimes be challenging and will be illustrated with one example dataset. Finally, the added-value of TKTD models for ERA will be discussed based on a number of different datasets.

352 A biology-based model to analyze growth data of earthworms exposed to copper at different development stages

S. Bajt, Amosse, C. Mougin, A. Péry, INRAE; F.A. Jorda, NWFSC; S. PELOSI, INRA (Institut National de la Recherche Agronomique)

Assessing effects of a contamination on populations requires getting data on the whole life cycle and accounting for differences of sensitivity throughout this life cycle. Copper contamination is one of the greatest concerns in agricultural soils, especially in vineyards. This contamination may have negative effects on soil fauna, such as earthworms, which are recognized as ecosystem engineers providing very valuable ecosystemic services. To assess effects of copper on earthworm populations, we tested the impact of a commercial formulation of copper fungicide, i.e., Cupra Micro® (50% copper oxychloride), on different endpoints, including growth, for the earthworm species Aporrectodea caliginosa, one of the dominant earthworm species in agricultural fields. We performed original tests assessing the impact of copper on the growth at 3 different development stages with many times of measurements: new born individuals (10–15 mg), juveniles (90–110 mg) and large juveniles (260–340 mg). To analyze simultaneously all the data, we developed and used a biology-based model. This model is based on the DEB (Dynamic Energy Budgets) theory. A DEB model was set up and validated under controlled conditions, using different food conditions. The growth data were then analyzed with a toxicokinetic-toxidynamic model (i.e., linking exposure and differences between development stages) coupled with a DEB-based toxicodynamic model. Our results showed a drastic inhibition of growth once a No Effect Concentration, estimated at 65 mg kg⁻¹ of copper for all stages, was exceeded. The time-profile of the effects was fully accounted for by the model. In conclusion, our model provided a relevant analysis of the toxicity data and provided an understanding of the mechanisms of copper toxicity to earthworm growth throughout development. The next step of our research will be to combine our biology-based model and reproduction data in a dynamic population model.

353 Connecting suborganismal and organismal responses using Dynamic Energy Budget Modeling and the ecological model species Fundulus heteroclitus exposed to dioxin-like chemicals

J.M. Stevenson, UCSB / Ecology, Evolution and Marine biology; E.B. Muller, University of California, Santa Barbara / Marine Science Institute; D.E. Nacci, B. Clark, U.S. EPA / Atlantic Ecology Division; A. Whitehead, University of California Davis / Environmental Toxicology; R.M. Nisbet, University of California Santa Barbara

Comprehensive and efficient management of ecological risk depends on our ability to quantitatively extrapolate the effects of stressors across levels of biological organization. Adverse Outcome Pathways (AOPs) connect sub-organismal mechanistic molecular data to organismal outcomes, while bioenergetics models, such as Dynamic Energy Budget (DEB), can extrapolate from individual- to eco-organizational levels of toxicant exposure. However, the connection between the two modeling frameworks remains a challenge. The molecular mechanisms underlying Key Event (KE) relationships defined in AOPs are often poorly known, even for well-studied compounds; thus, the mechanistic linkages between KEs and effects on DEB processes are often difficult to discern. Further, AOPs whose downstream outcome is lethality may be less informative to DEB models, which are important for bioenergetics. We address these challenges through theoretical and empirical efforts. We connect AOP KEs to DEB processes through a model of damage dynamics. The model predicts regulated but increasing concentrations of damage as the result of toxicant exposure and also tipping points when damage outpaces regulatory feedbacks, leading to mortality (Klanjscek et al. 2016). The connection between damage dynamics and DEB will be influenced by empirical and theoretical observations, but potential linkages include damage causing an increased maintenance cost or specific impacts on development. Specifically, we are studying the effect of DLCs on Fundulus heteroclitus (Atlantic killifish). DLCs are of particular interest in this species due to the large intraspecific variability in sensitivity. There is extensive data describing the toxic effects of DLCs through chronic exposure of the AHR positive species Fundulus heteroclitus. The mechanism of action of DLCs is not well understood. Further, sublethal effects of DLCs are less studied, but preliminary data indicate that sublethal PCB1216 exposure leads to slower growth in larval killifish (Nacci unpublished data). Therefore, this system offers a framework to test our ability to connect effects observed at the suborganismal level to bioenergetic processes through AOP and DEB modeling. We will measure suborganismal effects of DLCs (cytochrome P450 activation & transcriptomics) along with effects on development, growth, and reproduction. We will give an overview of our objectives and methods and report preliminary findings fitting DEB models and predictions of the effect of DLCs on the bioenergetics of killifish.

354 Quantitative Adverse Outcome Pathway Modelling of Endocrine Active Toxicants in Rainbow Trout

J.R. Schultz, NOAA NWFS / Marine Science Laboratory; L. Harding, University of Washington / Aquatic and Fishery Sciences; C. Monson, University of Washington / School of Aquatic and Fishery Sciences; K. Gillies, Pacific NW. Natural Resources; and the Windermere Fishery Science Center, Victoria, BC, Canada; A. Clark, University of Idaho; G. Young, Advisian WorleyParsons Group / Aquatic Sciences; J. Nagler, University of Idaho / Department of Biological Sciences; P. Swanson, NOAA-NWFS

We are investigating best approaches to utilizing in vitro derived toxicity data for estimating impacts on reproduction in trout and salmon. Our goal is to facilitate development of quantitative in vitro – in vivo extrapolation (IVIVE) methods to support adverse outcome pathway (AOP) based toxicity testing. We tested a diverse suite of toxicants using cellular assays based on the female rainbow trout pituitary, ovary and liver. Each assay measures an essential reproductive endocrine function.
such as estrogen synthesis and secretion by ovarian follicles. In vitro results are extrapolated to metrics of reproductive performance (fecundity, fertility, egg size) in trout using a mathematical model of the trout hypothalamus-pituitary-ovary-liver (HPOL) axis. We evaluated IVIVE by comparing predicted effects against laboratory results obtained from a yearlong exposure of female trout to four different chemicals: tamoxifen (biotransformed into the anti-estrogen 4-OH-tamoxifen), prochloraz (interferes with oocyte maturation), fluoxetine (SSRI pharmaceutical largely negated in our in vitro assays) and trenbolone (potent synthetic androgen). A single water exposure level was tested for each chemical, guided by preliminary studies and a desire to use a maximum tolerated exposure that still allowed spawning to occur. Laboratory exposures began 10 d after the first spawning cycle and lasted until time of ovulation and completion of the second spawning cycle (12-14 months later). Trout were euthanized and total fecundity determined along with egg mass and diameter, fertility, hatching success and larval growth. Results indicated no effect on fecundity was observed except after the 60 ng/L trenbolone exposure, which caused regression of ovarian growth and a failure to spawn in all exposed fish. Fluoxetine had no effect on reproduction. The most significant effects on egg quality occurred after the 500 ng/L tamoxifen (30% decrease in egg mass and diameter) and 20,000 ng/L prochloraz (increase in atretic / non-fertile eggs) exposures. The tamoxifen induced decrease in egg size translated to significantly smaller larva at 20 dph. The HPOL model, guided by in vitro testing, accurately predicted the reproductive effects of prochloraz and tamoxifen and the lack of effect by fluoxetine. Our results support the use of biologically based mathematical models of physiological systems in AOP testing. Supported by EPA-STAR grant R835167.

355 Development of a PBPK model for metal accumulation in fish infected with acanthocephalan parasites

Y.T. Le, University of Duisburg-Essen / Aquatic Ecology; M. Garcia, Spanish Council for Scientific Research; M. Nachev, University of Duisburg-Essen / Aquatic Ecology; E. Balsa-Canto, Spanish Council for Scientific Research; J. Hendriks, Radboud University Nijmegen; B. Sures, University of Duisburg Essen / Aquatic Ecology 

Fish are affected by both exposure to metals and infection. Each of these stressors may have effects on the response of fish to the other. Some effort has recently been made in developing kinetic models for predicting metal accumulation in fish-parasite systems. Our previous model allows for investigating the relationship between the accumulation in the whole fish and in the acanthocephalan, but does not include the mechanisms how metals are accumulated in parasites. Physiologically based pharmacokinetic (PBPK) model has been used for simulating the concentration of specific organ metals in fish. However, the capability of this model for simulating fish-parasite systems has not been investigated. We developed a PBPK model for simulating accumulation in the host-parasite system: chub (Squalius cephalus) and the acanthocephalan Pomphorhynchus tetracotilus. The acanthocephalan was considered a compartment, similar to blood, storage, gills, kidney, liver, and intestine. Metal accumulation in the system was modelled as a function of internal (i.e. exchange between different compartments) and external (i.e. exchange with water) factors. The transport from blood to other compartments depends on the diffusive exchange and the fraction of metals dissolved in blood plasma and was assumed to be independent of the infection state. The rate constants for this transport were parameterised based on published data. The model was then calibrated by MATLAB-based AMIGO modelling software for determining the rate of metal transport from storage, gills, kidney, liver, and intestine to blood, as well as the external exchange. Model calibration was carried out by using experimental data generated when the infected chub were exposed to Ag in 48-day exposure and 51-day depuration periods. The initial results from model calibration show potential of the PBPK model for simulating the accumulation of metals in fish-parasite systems. For example, the model could simulate the changes in the concentration of Ag in storage, gills, and intestine. The stability in the concentration of Ag in kidney was also simulated by the model. However, the model is being further calibrated to improve its capacity for modelling the accumulation in liver and in the acanthocephalan. The observed weakness of the current version in modelling the accumulation of Ag in these compartments might be related to the approaches for simulating the excretion of organo-metal complexes to intestine.

Solutions for emerging pollutants - Towards a holistic chemical quality status assessment in European freshwater resources (III)

356 High-throughput exposure and risk modelling of chemicals in European river basins

J. van Gils, DELTARES; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; h. baveco, Wageningen Environmental Research; L. Postuma, RIVM / Centre for Sustainability, Environment and Health; I. Cousins, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); C. Lindeborg, Stockholm University; S.S. Kutsarova, University of Zlatar; Laboratory of Mathematical Chemistry; S.D. Dimitrov, University of Zlatar / Dept of Comp Inform Technologies

SOLUTIONS is a EU 7th Framework Programme R&D project that aims at strengthening the management of emerging contaminants. It developed a collection of integrated models (the "Model Train"), to increase our understanding of issues related to emerging chemicals in Europe’s river basins, to support the prioritisation of chemicals and the abatement of the problems they cause and to evaluate future scenarios. The model train consists of four key building blocks: (i) the prediction of substance properties based on their molecular structure, (ii) the simulation of emissions, (iii) the simulation of fate & transport, and (iv) the characterisation of the risk of mixtures of chemicals for human health and aquatic ecosystems. The Model Train does not rely on extensive substance-specific input data. This implies that, to be generic and truly "embarrassingly parallel" in its calculations and for large numbers of chemicals ("real world exposure scenario"). The approach is validated for well-studied substances and data-rich basins. On this basis we learn how accurate our model based predictions are for new substances and data poor basins. The model train operates on the scale of Europe as a whole or for one or more individual river basins. It makes use of the pre-existing Europe-wide hydrology model E-Hype. The Model Train complements lab and field based approaches, by providing information for substances and sites which are not included in monitoring and by providing full time coverage. Validation results for the Danube, Rhine, four Spanish and a series of Swedish River Basins reveal that the accuracy of the simulated concentrations of a range of chemicals is higher for substances with a single type of use (e.g. pharmaceuticals, pesticides) and lower for substances with multiple uses. The predictability of the "Model Train" has been supported by a correlation with the observed ecological status as EU Member States report it under the Water Framework Directive. The SOLUTIONS Model Train will offer an effective tool to screen a large number of chemicals on their impact on Europe’s aquatic ecosystems, and to do so with consideration for spatial and temporal gradients as governed by socio-economic and meteorological/hydrological patterns in combination with the chemicals’ physical and toxicological properties. The presentation will include the validation results and will highlight some of the Model Train application results from SOLUTIONS.

357 Forward-looking on possible impacts of chemical pollution: Modelling lethal and sublethal effects of chemical exposure on population viability for aquatic macroinvertebrates

A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; I. Cousins, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); J. van Gils, DELTARES; S. Birk, University of Duisburg-Essen / Aquatic Ecology; c. Peeters, Wageningen University / Aquatic Ecology and Water Quality; P. van den Brink, Alterra Wageningen University; h. baveco, Wageningen Environmental Research 

One challenge in the quality assessment of water bodies in Europe is the ongoing difficulty to link the chemical and the ecological status. Currently, new approaches are developed to link chemical and biological monitoring results, hence providing the means to elucidate possible chemical impact on the ecological status of European water bodies in a retrospective way. Ecological modelling provides an alternative approach to connect exposure information to potential impact on biota, having the advantage that such modelling can be performed in a prospective way. This presentation will show results of ongoing modelling efforts in the EU 7th Framework project STREAM-EU. Streamline approaches are applied to link exposure dynamics of a number of chemical compounds to parsimonious individual-based population models. The STREAM-EU model provides exposure concentration results at the level of subcatchments, that is at a scale of tenths of km². Links between exposure and effects are realised using linear or log-logistic dose-response relationships. The ecological models account for lethal and sublethal effects on the population dynamics of a number of families of aquatic macroinvertebrates. Impacts of multiple chemicals are added up in the model following basic mixture modelling rules. Results depict the simulated inhibition of population growth rates and hence the chemical impact on population viability at European scales. Ecological modelling results are for some selected pairs of Europe compared with available monitoring information on the abundances of macroinvertebrate families in order to get an impression about the quality of the model predictions.

358 Eco-epidemiology of aquatic ecosystems: aligning chemical and ecological studies

L. Postuma, RIVM / Centre for Sustainability, Environment and Health; S. Birk, University of Duisburg-Essen / Aquatic Ecology; A. Burton, University of Michigan / School of Natural Resources / Environmental Stewardship and Sustainability Organization; D. De Zwart, DIAZ Ecotax / Centre for Sustainability Environment and Health; S.D. Yder, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; C. Lindeborg, Stockholm University; S.S. Kutsarova, University of Zlatar; Laboratory of Mathematical Ecotox. The STREAM-EU model provides exposure concentration results at the level of subcatchments, that is at a scale of tenths of km². Links between exposure and effects are realised using linear or log-logistic dose-response relationships. The ecological models account for lethal and sublethal effects on the population dynamics of a number of families of aquatic macroinvertebrates. Impacts of multiple chemicals are added up in the model following basic mixture modelling rules. Results depict the simulated inhibition of population growth rates and hence the chemical impact on population viability at European scales. Ecological modelling results are for some selected pairs of Europe compared with available monitoring information on the abundances of macroinvertebrate families in order to get an impression about the quality of the model predictions.

Solutions for emerging pollutants - Towards a holistic chemical quality status assessment in European freshwater resources (III)
359 Unravelling the cocktail of stress: toxics and other stressors impacting on the ecological status of Europe’s rivers
S. Birk, University of Duisburg-Essen / Aquatic Ecology; V. Bremerich, Leibniz-Institute of Freshwater Ecology and Inland Fisheries; O. Döring, DZfE, Ecotox / Centre for Sustainability Environment and Health; M.F. Sanchez, Leibniz Environment Management; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; L. Globenik, M. Koprivsek, University of Ljubljana / Faculty of Civil Engineering and Geodesy; J. Lemm, University of Duisburg-Essen; J. Mahnkopf, Leibniz-Institute of Freshwater Ecology and Inland Fisheries; Y. Panagopoulos, National Technical University of Athens / Laboratory of Hydrology and Water Resources Management; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; K. Stefanidis, National Institute of Public Health and the Environment; M. Venohr, Leibniz-Institute of Freshwater Ecology and Inland Fisheries Water management requires solid understanding of how multiple stressors affect ecosystem state and services. The EU project MARS (Mixing Aquatic ecosystems and water resources under multiple Stress) recently concluded four years of in-depth research on this topic. MARS looked into multi-stressor responses from experimental water body to pan-European scale, developed tools for modeling and diagnosing multi-stressor effects and guided management of multiply stressed aquatic ecosystems. Our presentation summarizes the key conclusions of the project, with a special emphasis on pan-European multi-stressor effects on the ecological status, including river hydrology, morphology, nutrient and toxic stressors.

360 Mitigation options for chemicals of emerging concern in surface water: operationalizing solutions-focused risk assessment
A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; A. Fischer, Utrecht University / Copernicus Institute of Sustainable Development; J. van der Hoek, Technical University Delft / Water Management. Chemicals of emerging concern (CECs) in the water cycle have been the focus of research to develop over the years. To minimize adverse effects, removal efficiencies of various (advanced) drinking water and wastewater treatment technologies have been studied. Advanced water treatment technologies are based on sorption, (advanced) oxidation and size separation. The paper presents a set of contemporary eco-epidemiological results, the recognition of ecological impacts in surface water systems and the diagnosis of probable causes. The paper presents the utility of that for chemical- and water quality assessment and management, thereby bridging preventive policies such as REACH via e.g. a Mixture Assessment Factor and environmental management practices such as EIA. We present novel results of scientific research at the nexus of chemical and water policies, connected to the European goals to reach a non-toxic environment and the good chemical and ecological status for aquatic systems. The presentation consists of the analyses of various sets of surveillance monitoring data using a combination of techniques originating from the fields of bioassessment and ecotoxicology. It thereby bridges these – so far often disparate – scientific disciplines, to support sustainable chemical and water policies. One of the most recent examples is provided by a diagnostic analysis in which the Good Ecological Status appeared associated to the Good Chemical Status, the latter shown to be a limiting factor for reaching a good ecological status. The presentation will provide a rationale for eco-epidemiological analyses as well as various types of results, from diagnostics to prospective state and services. The EU project MARS (Mixing Aquatic ecosystems and water resources under multiple Stress) recently concluded four years of in-depth research on this topic. MARS looked into multi-stressor responses from experimental water body to pan-European scale, developed tools for modeling and diagnosing multi-stressor effects and guided management of multiply stressed aquatic ecosystems. Our presentation summarizes the key conclusions of the project, with a special emphasis on pan-European multi-stressor effects on the ecological status, including river hydrology, morphology, nutrient and toxic stressors.

361 Future perspectives of chemical pollution and regulatory development
J. Munthe, IVL Swedish Environmental Research Institute Ltd; T. Skärman, IVL Swedish Environmental Research Institute; E. Brorström-Lundén, IVL Swedish Environmental Research Institute / SETAC Europe; M. Rahmberg, E. Westberg, IVL Swedish Environmental Research Institute; D. Bunke, Öko-Institut e.V. / Sustainable Products & Material Flows Division; K. Sackmann, ÖKEFO Institute Future developments in society will result in the emission of new substances to the environment which will require an adaptation of existing legislation for protection of human health and ecosystems. Scenarios for the future development of society can provide valuable indications on changes in future pollutants in river basins. Some developments are directly connected to consumption of specific substances, e.g. demographic change where a longer life expectancy will lead to changes in amounts and types of pharmaceuticals used and thus also to the related concentrations in the environment. Future technological progress may help to identify and reduce alternative uses for the same substances. The overall result is that the future is likely to show a decreased number of new substances with potential consequences for chemical use and releases: public health, food production, urbanization and technologies. With these future developments and the resulting introduction of new substances from new sources, an adaptation of current regulatory frameworks is required. However, to prepare for a future with unknown scenarios for use and emissions of potential chemical pollutants is naturally difficult but a general approach can be developed and adopted to prepare for a future where environmental pollution by chemicals is avoided or minimised. This general approach should build upon a few basic principles: (1) The solutions-focused approach, where the same attention is given to evaluation options for minimising risks as to quantifying risks for new substances under development or introduction; (2) Transparency and openness of information and knowledge. Current applied research aimed at providing solutions to identified problems of chemical contamination in e.g. water ecosystems is severely limited by a lack of information on the production and use of chemicals in society as well as on emissions to water. Linkage of national databases on use volumes of industrial chemicals such as SPIN (Substances in Preparations in Nordic Countries) would allow tracking quantitatively substitution of the most problematic substances; (3) Increased international cooperation and strengthened global agreements. The world is globalised and the transport of chemicals is transboundary – both via the atmosphere and via global trade.

Economic risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (I)

362 Towards a systematic approach for the assessment of multiple stressors: Making Aquatic Ecosystems Great Again (MAEGA)
D.J. Baird, Environment Canada; R. Schafer, University Koblenz Landau / Institute for Environmental Sciences; C.B. Cheung, Environment Canada/Canadian Rivers Institute / Department of Biology; A. Bush, Environment and Climate Change Canada; S. Bracewell, Wageningen University & Research / Department of Aquatic Ecology and Water Quality Management; A. Chariton, Macquarie University / Molecular Ecology and Toxicology; Z. Compson, Environment and Health
The combined effects of nutrients and thiacloprid on macrofauna invertebrate population and community responses

H. Barmentlo, Leiden University; M. Schrama, CML Leiden University / Conservation Biology; K.J. Musters, Leiden University / Institute of Environmental Sciences; P.M. Van Bodegom, CML Leiden University / Institute of Environmental Science CML; G. de Snoo, Leiden University / Institute of Environmental Sciences; M.G. Vijver, CML Leiden University / Conservation Biology

Ditches are commonly used to control for fluctuating groundwater tables in agricultural landscapes. They provide a strong linkage between agricultural fields and adjacent water bodies as they are a common sink for agricultural chemicals such as neonicotinoid insecticides and fertilizers. As these agrochemicals are bound to sediments and algae in ditches, they may increase the toxicity of chemical pesticides, it is unknown whether it also may increase the toxicity of chemical pesticides, it is unknown whether it also

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The combined effects of nutrients and thiacloprid on macrofauna invertebrate population and community responses

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Macroinvertebrate communities across a gradient of multiple stressors from agricultural land use in Romanian streams

V.C. Schreiner, M. Link, S. Konz, E. Stoeves, University of Koblenz Landau; B. Verdonschot, Eawag; K.P. Battes, M. Cimpean, Babes-Bolyai University; E. Vermeiren, Ecotone Centre Eawag-EPFL / Aquatic Ecotoxicology; H. Singer, Eawag, Swiss Federal Institute of Aquatic Science and Technology; K.P. Battes, M. Cimpean, Babes-Bolyai University; E. Vermeiren, Ecotone Centre Eawag-EPFL / Aquatic Ecotoxicology; H. Singer, Eawag, Swiss...
different mode of action (the chemical pesticide Chlorpyrifos, CPF, and the biopesticide Bti) in the mosquito *Culex pipiens*. We expected that the effects of the single exposures are strengthened in the presence of DTV. In addition, we tested whether there is an interaction between CPF and Bti and whether this interaction is magnified in the presence of DTV. We crossed three DTV treatments (no DTV, a small DTV of 7°C and a large DTV of 14°C) with four pesticide treatments (a solvent control, single CPF exposure, single Bti exposure and exposure to the CPF-Bti mixture). We measured the effects on larval population growth rate (*r*) and its key components. The experiment was done in three steps: (i) 4-day exposure in L4 to DTV, (ii) 2-day exposure to DTV and the pesticide treatment and (iii) exposure to DTV until metamorphosis. The presence of a large DTV increased the toxicity (based on *r*) of the chemical pesticide, but not the biopesticide. Moreover, a large DTV changed the toxicity of the CPF-Bti mixture. For example, the presence of large DTV removed the antagonistic interaction effect on total mortality which was present in the absence of DTV and in the presence of small DTV. Our results underscore the importance of considering DTV as a factor shaping not only the toxicity of pesticides but also the interaction type between pesticides in mixtures. Given DTV occurs in all natural populations and may strongly differ between latitudes, DTV may be an important factor causing a mismatch between toxicity studies done in the lab at constant temperatures and the toxicity of pesticides and their mixture in the real world.

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**Watering and daily temperature fluctuations make the pesticide chlorpyrifos more toxic in *Ishunura elegans* damselflies.** J. Verheyen, R. van Roo, KU Leuven / Biology; R. Stoks, University of Leuven / Department of Biology

Current risk assessment of pesticides fails to protect aquatic biodiversity. A key reason is the lack of realism: pesticides are tested under ideal laboratory conditions at one mean temperature. To strengthen current risk assessment it is crucial to incorporate effects of global warming on the toxicity of pesticides. Global warming studies largely overlook that climate scenarios also predict stronger daily temperature fluctuations (DTFs), which can have greater fitness effects for organisms than increases in mean temperatures. While many pesticides (like organophosphates) get more toxic at higher temperatures, it is largely unknown how DTFs influence the pesticide toxicity. We examined a multi-factor scenario where we quantified the single and combined effects of (i) increases in mean temperature and (ii) in DTF, and (iii) exposure to the pesticide chlorpyrifos (CPF) in larvae of high- and low-latitude populations of *Ishunura elegans* damselflies. CPF imposed mortality and more so in high-latitude compared to low-latitude larvae. Moreover, CPF was more toxic at 24°C compared to 20°C, confirming the higher toxicity of organophosphates at higher temperatures. A key finding was that DTF also increased the toxicity of CPF, providing novel evidence that DTFs can amplify the toxicity of pesticides. Furthermore, the increased toxicity of CPF by DTF was more pronounced at 24°C. This novel pattern is likely general as at a higher mean temperature, DTF will expose the animals to even higher temperatures during the daily cycle, thereby increasing exposure to stressful temperatures. Also, the negative effect of CPF on larval growth strongly depended on DTF. CPF did decrease larval growth considerably, but only in the 10°C DTF treatment. Probably the higher metabolic demands for cell maintenance in the 10°C DTF treatment resulted in lower growth rates. Our results convincingly show that the organophosphate pesticide chlorpyrifos is not only more toxic to damselfly larvae at the higher mean temperature (24°C) but also at higher daily temperature fluctuations (DTFs). The behavior of plant detoxification enzymes were evaluated at lab-scale for their removal by different options including powdered activated carbon (PAC), high pressure membrane processes and transformation by ozone and chlorine. Highly polar PMOCs such as adamant-1-amine (Log D = -2.34), trifluoromethanesulfonate (Log P = -1.35) and 2-capsrolactam (Log P = 0.15) were not removed by PAC even for very high doses. Only naphthalenesulfonate (Log P = -0.41) was fully removed for 5 mg L⁻¹ PAC. The other PMOCs i.e. aromatic sulfonates, aromatic amine, phenols, were removed significantly for high PAC doses, but that are not compatible with drinking water production. Most of the PMOCs identified in water resources showed a very low reactivity with ozone with rate constants below 100 M⁻¹s⁻¹ and thus will not be transformed during ozonation of drinking water. Two aromatic guanidines, the 1,3-di-penylguanidine and the 1,3-di-o-tolyguanidine, an olefinic sulfonate and an amine compound, the N-benzyl dimethylamine, were rapidly transformed by ozone. Transformation of both guanidines occurred in few seconds at neutral pH during disinfection by chlorine. Chlorinated and hydroxylated analogues, and products of cleavage and cyclization were identified. US EPA toxicity prediction tool showed that some of the identified compounds were more toxic than the parent compound, which was confirmed by Microtox acute toxicity test for Cl₂/guanidine ratio of 1 and 10. Thus, reactions with chlorine during disinfection can be a source of new, persistent and more toxic chemicals in drinking water. Some PMOCs like 2-capsrolactam, halogenated methanesulfonates, adamant-1-amine and triazine compounds will neither be removed by adsorption on activated carbon nor by oxidation and can thus be present in drinking water. High pressure membrane processes would constitute the ultimate barrier for these compounds.

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**Removal of polar micropollutants from drinking water by reverse osmosis: a pilot scale study.** V. Albergamo, University of Amsterdam/IBED Institute / IBED; E. Cornelissen, KWR Watercycle Research Institute; B. Blankert, Oasen; W. Knibbe, University of Wageningen; W. Van der Meer, Oasen & University of Twente; P. de Voogt, University of Amsterdam / IBED

The occurrence of polar micropollutants (MPs) in drinking water sources is regarded as one of the most challenging issue of our times. Polar MPs can preferentially remain in the water phase during environmental and water treatment processes, potentially reaching finished drinking water and thus raising concern over adverse effects to human health. In The Netherlands reverse osmosis (RO) has been proposed as a stand-alone treatment capable of producing impeccable drinking water. Modern reverse osmosis (RO) systems are capable of retaining organic compounds depending on physicochemical properties such as size, charge and polarity. The aim of this study was to assess whether riverbank filtration followed by RO can provide sufficient removal of MPs and thus be considered for further implementation. We also aimed to elucidate the transport of organic solutes through RO membranes by relating solute physicochemical properties to solute passage. A novel pilot-scale RO system capable of operating in aerobic conditions was built for this study. Raw anaerobic riverbank filtrate was used as feed water. The feed was spiked with 30 target polar MPs selected from scientific literature and considered relevant for the quality of source waters and critical for

**PBT/vPvB & PMT/vPvM substances and Non-extractable residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (I)**

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**RPLC-HILIC and SFC coupled with Mass Spectrometry: Polarity Extended Screening of organic molecules in the aqueous environment.** S. Bieber, Technical University of Munich / Chair of Urban Water Systems Engineering; S. Grosse, T. Letzel, Technical University of Munich.

Trace organic compounds are important in environmental analysis, because they impact water quality and introduce potential (eco)toxicological effects. Current analytical methods mostly rely on gas chromatography (GC) or reversed-phase liquid chromatography (RPLC) coupled with (tandem) mass spectrometry. However, neither method can easily separate very hydrophilic molecules. Two chromatographic separation strategies, a serial RPLC- hydrophilic interaction liquid chromatography (RPLC-HILIC) coupling and an analytical scale supercritical fluid chromatography (SFC) system will be presented, and their separation effectiveness as polarity-extended chromatographic methods for 274 environmentally relevant compounds were validated in a recent publication [1]. Compounds tested were grouped into three polarity classes, “very polar” log D (pH 7) below -2.5, “polar” log D (pH 7) -2.5 to +2, and “non-polar” log D (pH 7) higher than +4.2. Nearly all compounds could be retained in both systems with relative standard deviations of retention times (RT) (n = 6) typically between 2 and 5%. Both techniques have considerable benefits when combined with accurate mass spectrometric detection. Molecules RT and accurate mass were recorded in a database for each set up. This information was used for compound screening modules as well as “hidden-target screening” in complex environmental matrices (such as wastewater treatment plant influent samples) complementary and useful for all types of molecules polarity. In this study, more than 80 percent of the compounds found in wastewater treatment plant effluent samples possessed a negative log D (pH 7) value. This result highlights the basic necessity to include “very polar” compounds in water monitoring techniques and protocols [1]. S. Bieber, G. Groen, S. Grosse, T. Letzel: RPLC-HILIC and SFC with mass spectrometry: Polarity-extended organic molecule screening in environmental (water) samples. Analytical Chemistry 2017, 89 (15), 7907-7914 (DOI: 10.1021/acs.analchem.7b00859).

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**Removal options and transformations of persistent mobile organic chemicals during production of drinking water.** A. TOUFFET, IC2MP CNRS; H. Gallard, IC2MP; B. Sieira, University of Santiago de Compostela; j. Chokki, b. teychene, IC2MP CNRS; R. Montes, University of Santiago de Compostela; R. Rodil, University of Santiago de Compostela; J. Quintana, University of Santiago de Compostela

Extended organic molecule screening in environmental (water) samples. Analytical Chemistry 2017, 89 (15), 7907-7914 (DOI: 10.1021/acs.analchem.7b00859).

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RO. Feed water samples were analysed by direct injection, whereas RO permeate samples where enriched by solid-phase extraction. The analysis were carried by ultrahigh-performance liquid chromatography coupled to time-of-flight high-resolution mass spectrometry. Neutral polar MPDs displayed less than 5% passage, except benzoazolyl, tolyltriazole and phenylurea, which displayed a passage of 25%, 17% and 10%, respectively. The data showed that removal of neutral polar MPDs is mainly governed by size exclusion. For neutral and moderate polar MPDs the inverse was true. A major influence was the electrostatic potential of the membrane, as seen for bisphenol A, which displayed 4% passage. The higher passage of moderately polar and hydrophobic MPDs could be attributed to solute-membrane hydrophobic interactions followed by diffusion. All anionic MPDs displayed less than 1% passage, opposed to cations for which up to 10% passage was observed. The negative character of the membrane surface could explain the results. Overall this study showed that high chemical removal rates can be achieved by RO. Tighter membranes and multi-stage RO will be investigated to improve the removal of small neutral MPDs for drinking water applications.

371 Identification of transformation-derived very polar organic contaminants and their relevance in the water cycle

D. Zahn, Hochschule Fresenius / Chemistry and Biology; P. Mucha, V. Zilles, Hochschule Fresenius, University of Applied Sciences; A. Touffet, H. Gallard, IC2MP UMR 7265 CNRS - University of Poitiers; T.P. Knepper, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology; T. Frömelt, Hochschule Fresenius, University of Applied Sciences

Highly polar organic substances are well water soluble, non-volatile, and exhibit only minimal adsorption to nonpolar surfaces. Therefore, they may be able to penetrate natural and artificial barriers and are thus mobile in the water cycle.

If these mobile organic contaminants (MOCs) are persistent (PMOCs) against mineralization or a dead end TP is formed, thus potentially resulting in persistent and highly polar transformation products (TPs). Many PMOCs derived from transformation processes may still be unknown and thus not be represented in suspect or target screening campaigns. As a consequence, no information about their occurrence and origin is available, which severely exacerbates the sophisticated monitoring and effective regulation of their precursors. Based on the work of Arp et al. and Schulze et al., we selected 15 industrial chemicals with a high expected potential to form transformation products during application and studied their behaviour during hydrolysis, biotransformation, oxidation with MnO₂, and photolysis experiments. After structural elucidation of the 9 detected transformation products with high resolution mass spectrometry (HRMS) we developed a qualitative HILIC-MS/MS (Hydrophilic interaction liquid chromatography – MS/MS) method and screened 25 Hessian surface waters for the presence of these TPs. While some TPs were not detected, other TPs were found in the majority of the screening data provides first information about the potential environmental relevance of the identified TPs, which can be used to prioritize them for inclusion in future quantitative screening campaigns.

372 The limited chemical application domain of regulations: An illustration using the POP screening assessment in the Stockholm Convention

M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES)

Regulatory frameworks are initiated by a societal concern and built upon the scientific knowledge existing at the time they are written. This imparts them with a chemical application domain, i.e. a chemical property space in which the frameworks can be applied in the context for which they were conceived and supported by a sound scientific foundation. As time passes, societal concerns change, and this can lead us to want to apply regulatory frameworks outside of their chemical application domain. Today we have the ambition to regulate tens of thousands of chemicals in regulatory frameworks that were in some cases developed 20 years ago with a more modest level of ambition and less scientific knowledge than we have today. Are these regulations really up to the task? This question is explored using the example of the POP screening assessment in the Stockholm Convention. Using perfluorinated alkyl acids (PFAs) and octamethylcyclotetrasiloxane (D₄) as case studies, it is shown how this framework can lead to both false negative and false positive conclusions. False negative classification of PFAs can arise because of the inclusion of bioaccumulation as a screening criterion in the framework although bioaccumulation is not a requirement for adverse effects of chemicals in remote regions. False positive classification of D₄ can arise because the four screening criteria (persistence, bioaccumulation, long-range transport, and adverse effects) are not valid in the same environmental media/compartments. It is concluded that if we wish to conduct POP assessment for the broad spectrum of chemicals in modern commerce, then we will have to rely less on individual screening criteria and instead apply models that can capture and integrate the broad diversity of chemical behaviour.

373 'One for all and all for one' - Can we REACH a harmonised PBT-assessment across EU-regulatory frameworks?

C. Rauert, Umweltbundesamt / International Chemical Management; A. Böhmhardt, German Environment Agency, J. Prieznitz, Umweltbundesamt / FG I4 1.3 - Pflanzenschutzmittel; A. Wiemann, UBA Umweltbundesamt; J. Schmidt, German Environment Agency

Persistent, bioaccumulative and toxic (PBT) substances and REACH are frequently called in one breath. However, also other European regulatory frameworks for chemicals, such as for biocides, plant protection products (PPP), veterinary and human medicinal products (VMP/HMP) stipulate the performance of a PBT-assessment during substance evaluation. As in other hazard based assessments (e.g. GHS/CLP regulation, POP), the PBT/vPvB assessment focuses on the properties of a substance only and does neither take into account the use of the substance nor its exposure. Consequently, the identification of a PBT or vPvB substance should be independent from the regulatory framework under which it is assessed. However, in our comparison of conclusions on PBT properties for a number of substances falling under more than one legislation it became apparent that the outcome of the PBT assessment does not necessarily correspond between different regulations. This stands in contrast to the goals to perform a comprehensible and consistent assessment of chemicals and to ensure a high level of protection of human health and the environment against hazardous chemicals within the EU. In order to elucidate the reasons still hampering a harmonised PBT-assessment, we did a compilation of a number of technical (amount and quality of data, acceptability of specific data, derivation of endpoints, applied guidance documents), and conceptual criteria (numerical criteria, testing strategy, assessment of transformation products) as well as of other factors (consequences of PBT-assessment, data management and publication of assessment results).

Outgoing from this, we developed several proposals facilitating a harmonised PBT assessment, starting from the implementation of an overall PBT-guidance up to an inclusion of transformation products in the PBT-assessment by all regulatory frameworks. Although it cannot be denied that a harmonisation process is ongoing, we conclude that there are still some fundamental choices to be made both at the organisational level and at policy level first to achieve the goal of a standardised PBT identification among EU legislations.

Product benefits and positive outcomes: valuation and beyond

374 A need for a better characterisation of product benefit in life cycle sustainability assessment

T. Schaubroeck, Luxembourg Institute of Science and Technology (LIST) / Research Group EnVOC; E. Benetto, Luxembourg Institute of Science and Technology (LIST) / Environmental Research and Innovation

In life cycle assessment (LCA) the main focus is on damage assessments of production systems. These damages are conventionally characterized per so called functional unit. In practice, however, these functional units are partially descriptive, e.g. white light from a point source with 1500 lumen, and not well assessed. In the first part of this study we therefore further elaborate the functional unit towards product benefit. When taking a closer look at the concept of functional unit, it is imperative to define what functionality implies. Products have been created to fulfill human needs, e.g. the need for light at night provided by a light bulb. Through fulfillment of needs, human well-being is induced. The characterisation of the actual functionality hence boils down to the assessment of this well-being effect. In consequential LCA, not only the consequences related to the needed activities associated with the product life cycle should after all be considered, but also those associated with the benefit induced by the product. In the second part, we specify how a better product benefit characterisation could improve life cycle assessment and its policy support. Three advantages are specified. First, as these functional units are often not specifically defined and a product can have multiple functions, comparison is often impeded in practice. Under this second perspective products can be compared directly the same. A better specification of the functional unit in terms of an aggregated single score for product benefit, such as the net impact on human well-being, would permit to compare all types of products. Second, not only would a better characterisation of the product benefit allow for a better comparison of various production systems, it also allows one to compare the benefit of the product with the damage provided during its production. One can then disseminate a holistic sustainability system through the profit or loss of not having it. Third, when an additional amount of byproduct is created by a production system, this may also induce a byproduct benefit, which can be
accounted for as such, in fact, when a byproduct enters the market, a share of it can lead to a decrease in supply (substitution approach) but another share can also lead to an increased demand and thus consumption, which satisfies needs that were previously unassisted (production benefit approach). A consideration of both effects is needed in CLCA.

375 Assessing nutritional impacts and benefits on human health in LCA: A new midpoint impact category

K. Stylianou, University of Michigan - School of Public Health / Environmental Health Sciences; V.L. Fulgoni III, Nutrition Impact, LLC; O. Jolliet, University of Michigan

Defining a crucial determinant of human health, According to the Global Burden of Disease (GBD), dietary risk factors are responsible for >10 million deaths/year globally. Yet, beneficial and detrimental nutritional health effects, the dominant pathway for health in food systems and diets, are often neglected in Life Cycle Assessment (LCA). To address this, we develop 14 nutritional characterization factors (CFs) for food groups and nutrients using epidemiological evidence from the GBD, and propose a new nutritional midpoint impact category for LCA, demonstrating its application to the entire US diet. We develop marginal nutritional CFs for 8 major food groups (nuts and seeds, whole grains, fruits, vegetables, milk, sugar-sweetened beverages, red meat, and processed meat) and 6 nutrients (omega-3, calcium, polyunsaturated fats, trans fats, and sodium), identified by the GBD as dietary risk factors. CFs are estimated by coupling age- and gender-adjusted information on outcome-specific incidence rates with risk ratios (RR) and severity factors, measuring positive or detrimental effects in avoided \( \text{DALY}\)/y. We also develop a profiling system for 6000+ food items consumed in the US that aligns publically available data from multiple databases with risk factor definitions from the GBD. Finally, for 6000+ food items we estimate the Health Nutritional Index (HENI), the total avoided health burden from all dietary risk factors per serving and 100 kcal. Nutritional CFs for food group and serving size range between -8 avoided \( \text{DALY}\)/y for sodium, up to 57 avoided \( \text{DALY}\)/y for omega-3 from seafood. HENI score typically ranges from -80 avoided \( \text{DALY}\)/serving for Frankfurter sandwiches to 50 avoided \( \text{DALY} \)/serving of nuts and seeds. Absolute HENI scores and ranking of food items vary substantially when using 1 serving or 100 kcal as a functional unit. Unhealthy food groups such as mixed dishes and protein foods with the exception of seafood and nuts and seeds have negative HENI scores primarily due to detrimental effects from processed and red meat, saturated and trans fats, and sodium. Healthy food groups such as fruits, grains, and vegetables excluding starchy vegetables tend to have positive HENI scores dominated by health benefits from their respective food groups. The estimated nutritional CFs create a new midpoint impact category in LCA that would improve human health impact assessment in LCA and allow for a comprehensive assessment of food items and diets.

376 Combining Operational Research and Life Cycle Assessment to optimize the environmental performance of Peruvian diets

L. Vázquez-Rowe, Pontificia Catholic University of Peru / Civil Engineering Environmental Science; G. Lorrea-Gallegos, Pontificia Universidad Católica del Peru / Civil Engineering Environmental Science; A. Gilarindo, Pontificia Universidad Católica del Peru / Industrial Engineering

Food production and security has been highlighted as one of the most threatened sectors worldwide due to consequences of climate change. However, food production is also responsible for an important fraction of GHG emissions. In Peru, 1/3 of household expenditure is destined to food purchase. In contrast, malnourishment is still rampant in many socioeconomic sectors, mainly in the Highlands in the Amazon basin. In this context, it appears as a major challenge to jointly achieve nutritional improvements in the Peruvian diet and reductions in terms of GHG emissions. Hence, the main objective of this study was to apply a methodology which allowed optimizing the environmental profile of the Peruvian diet while improving its nutritional requirements at competitive economic costs. In other words, the aim of the optimization model was to determine an optimal diet from an environmental perspective considering nutritional and economic constraints. For this joint combination of Operational Research and Life Cycle Assessment was performed. Based on the average diets identified for each city included in the study, an optimization was performed considering a set of criteria that respond to the three dimensions of sustainability. Nutritional aspects were included in the model through a restriction based on the minimum consumption of food types and caloric intake recommended by Peruvian authorities. Regarding economic aspects, the model included a set of inequations that limited the minimum and maximum monetary changes throughout the year (i.e., 2016). Finally, environmental aspects were considered by introducing an objective function that minimizes the emissions of CO\(_2\)-eq of the entire food basket. The result of the proposed linear program allows understanding the amount of each individual food product that should be consumed in each city that satisfy all the restrictions included in the model in order to attain the lowest GHG emissions possible. AMPL\(^\text{®}\) was used as the programming platform, and CPLEX\(^\text{®}\) as the solver. Results demonstrated that substantial reductions can be attained in GHG emissions through the optimization of diets in Peru. For instance, in Lima the reduction could reach 200 kg CO\(_2\)-eq per person and year (22%). These results constitute an important framework to understand the current situation of the GHG emissions of the average Peruvian diet, as well as to mitigate these emissions while improving nutritional aspects and controlling economic costs.

377 Using the first Swiss dietary survey to determine the environmental and health benefits and impacts of various dietary patterns

A. Ernstoff, Quantis / Quantitative Sustainability Assessment; S. Humbert, X. Bengoa, M. Vargas Gonzalez, Quantis; O. Jolliet, University of Michigan

Many studies compare the environmental impacts of dietary patterns such as dietary recommendations (e.g. food pyramids), vegetarian and vegan diets. Mounting evidence suggests diets high in red meat and other animal products have higher associated environmental impacts. A hypothetical non-meat diet is often considered in such assessments, which may e.g. be equi-calorie or mass to the meat containing diet. In this study we use the first Swiss National Survey (MenuCH) to determine what non-meat eaters consume in Switzerland and what potential environmental and health benefits (or impacts) may result from assessing realistic consumption. About 5% of the Swiss population self-identifies as vegetarian, and less than 1% as vegan. Meatless diets contained about the same overall mass of food consumed, generally offered environmental and health benefits through increased fruit and vegetable consumption, but vegan diets can be insufficient in certain essential vitamins if not supplemented. Nuts, seeds, and their oils were important sources of key nutrients such as vitamin E. In conclusion, using dietary surveys can help provide us with evidence as to what goes on. Our study looks into the monetary values of other animal products from the diet. Accounting for the environmental and health benefits of realistic dietary patterns, can help support improved recommendations.

378 The cost of CO\(_2\) in Life Cycle Assessment

Y. Dong, Technical University of Denmark; R. Rousselet, Ecole Centrale de Marseille / Engineering School; H. J. Sørup, Technical University of Denmark / DTU Environment; P. Fantke, Technical University of Denmark / Quantitative Sustainability Assessment Division; M.Z. Hauschild, Technical University of Denmark / DTU Management Engineering Division / Quantitative Sustainability Assessment

Climate change has gained increasing attention over the past decade in response to the revelation that we need to maintain a viable climate for humans and the environment. The increasing emission of greenhouse gases (GHG) such as CO\(_2\) may accelerate climate change and cause subsequent damages. Correspondingly, countries and companies actively develop strategies to minimize their GHG emissions and thus climate impacts, but which strategies that will be more beneficial is often hard to evaluate. Life Cycle Assessment (LCA) is a tool to evaluate the damages of GHG emissions from the whole life cycle of the intended strategies, taking a cradle-to-grave perspective. By monetising the impacts related to these emissions, they can be compared to the overall cost of a strategy. This secure that emissions are considered in determining the priority and benefits of the removal reduction strategies. Our study looks into the monetary values of GHG, represented by CO\(_2\)-eq (or CO\(_2\)-equivalent), and their underlying cause-effect chains in three Life Cycle Impact Assessment (LCIA) methods LIME2, EPS2015 and ReCiPe2016. The damage cost for CO\(_2\) is in the same order of magnitude in EPS2015 and ReCiPe2016, but one order of magnitude higher than that in LIME2. Climate change-related damages on human health are well represented in all LCIA methods, and the monetised damages from this category contribute to more than 70% of the total CO\(_2\) cost in all three methods. Social assets and ecosystem damages, on the other hand, are only counted for in two of them. Furthermore, a range of potential socio-economic damages from a changing climate are discussed in IPCC reports, including economic loss from extreme weather events, costs of potential climate-related society security and poverty, but they are not included in any of the LCIA methods. This may limited the suitable application area of the CO\(_2\) cost evaluated by LCA, especially in studies where social and economic consequences are the major concerns. The CO\(_2\) costs from the three LCIA methods are further evaluated in comparison with approaches from other research fields, such as Social Cost of Carbon (SCC), and discrepancies and associated uncertainties are discussed.

379 Poster spotlight: WE257, WE258, WE259

Advances in monitoring and evaluating remedy effectiveness for in situ amendments in soils and sediments

J. Kvasnicka, University of Michigan, Ann Arbor USA / Environmental Health Sciences; K. Stylianou, University of Michigan - School of Public Health /
Environmental Health Sciences; G. Burton, University of Michigan / School for Environment and Sustainability; J. Semrau, University of Michigan - Civil and Environmental Engineering and Program in the Environment; O. Jolliet, University of Michigan

Billions of dollars have been spent on environmental dredging projects to remediate contaminated sediments. However, the extent to which this remedy can reduce human health risks is unclear. Environmental dredging projects can alleviate health impacts from contaminated sediments, but these potential adverse effects are usually not quantified in a manner conducive to comparing them to potential benefits and assessing overall remedy effectiveness. Focusing on the Hudson River PCBs Superfund Site remediation, this study demonstrates a novel approach to comprehensively evaluate the relative tradeoffs between population health benefits and risks associated with different remedial alternatives. The specific aims were to: 1) Assess health impacts on recreational anglers for a No Action scenario, due to bioaccumulation of PCBs in Hudson River fish, and exposure through fish consumption. 2) Determine and compare the reduction in health impact from reduced fish tissue PCB concentrations associated with different remedial options relative to No Action. 3) Investigate potential health impacts of the selected remedy from resuspension of sediment, air emissions of PCBs, diesel particulate matter (DPM) and NOx, and occupational incidents. 4) Compare the avoided health impacts, i.e., the health benefits, with the created health impacts. For each considered impact pathway, we derived both central and upper bound estimates, using the disability adjusted life year (DALY) as a comparative metric. For the No-Action scenario, the health impacts are 11 and 78 DALYs, respectively. The remediation options explored here provide an alternative that achieves a 90% reduction in health impact, without the need for substantially more expensive and labor-intensive remediation. Potential benefits of MNA are further highlighted when resuspension is assumed as an important factor. Furthermore, potential health impacts created by the selected remedy are within the same order of magnitude as potential benefits. Our study shows the importance of validating efficacious and safe (nano)materials before use, especially with several nanoparticles, and multiple heavy metals contamination. This new solution, will enable to reduce contaminated sludge and sediments, in terms of volumes and costs of transport, but also to convert the resulting solid and liquid wastes to a renewable clean resource to be use in several other applications. The results of several preliminary trials in which ecotoxicology (bioassay and biomarkers approach) has been used to validate efficacy of phytoremediation and assess ecosecurity (safe-by-design) of use of engineered nanomaterials and nanoparticles (ENMP) for environmental remediation, known as nanoremediation, represents a challenging and innovative solution, environmental and human risk assessment associated with the use of ENMP is still a matter of debate. Limited in situ applications to water and soil remediation hindered by lack of data, are often used for extrapolation of impacts and there is a general demand for strategies aimed to fulfill such needs. As the potential and efficacy of nanotechnologies is well established, several drawbacks related to full-scale application should be overcome. In particular, great efforts should be devoted to develop (nano)materials which own eco-friendly features such as limited release and mobility in environmental matrices as well as no toxicity for natural ecosystems. Ecostoxification can be thus used to develop eco-friendly (nano)materials for environmental application and to provide monitoring methods in a weight-of-evidence approach also to support decision-makers. The NANOBOND project (Nanomaterials for Remediation of Environmental Matrices associated to Dewatering) funded in 2015 by POR CReO FESR Toscana 2014-2020, is developing an innovative system for treating contaminated sludge through sediment dredging. For this project, the study was creatively designed, to test the hypothesis that the most effective systems for sediment remediation are those that increase both the rate of removal of contaminants from the sediment and of the remediation of organic and mineral pollutants present in the test systems, the AC layer was mixed well with the overlying sediment, allowing for a measurable remediation success. With the deeper dwelling, this effect could only be observed with minimal sediment coverage of the AC (<5 mm). 

381 Sixes inches under: Remediation efficiency of activated carbon caps buried by dynamic sediment movement S. Abel, J. Akkanen, University of Eastern Finland / Department of environmental and biological sciences

The study focused on how a recently activated carbon (AC) based thin layer caps is a promising and novel in-situ remediation method for contaminated sediments. The method utilizes the adsorptive capabilities of AC, allowing it to strongly bind persistent organic pollutants, thus greatly reducing the contaminants’ bioavailability and sediment to water flux. Sediment capping with active materials can furthermore provide a less destructive, low-cost alternative to traditional remediation methods, such as sediment dredging. As in this study, the method was tested in a real-life, inter-realistic conditions with the first field trial on AC based sediment remediation in Finland. At the test site in the PCB-contaminated Lake Kernaalanjärvi, a 300 m² plot was amended with an AC thin layer cap (1.6 kgAC/m²). Due to the shallow nature of the lake and its large surface area, highly dynamic sediment movements occurred over the monitoring period of 14 months. As a consequence, the AC cap was buried rapidly under a large amount of the untreated sediment, leading to a low measurable impact of the AC amendment. Neither benthic community structure nor PCB bioaccumulation in local benthic organisms were significantly different on the AC amended plot and the surrounding reference sites. The amount of sediment deposited was high (34.2 g dry matter/m²/day), making detailed observations on the development of the situation over time difficult. To investigate the potential for a long term remediation success of AC caps even under these unfavorable conditions, a corresponding laboratory study was conducted. The field scenario was replicated in test vessels containing a base layer of PCB contaminated sediment topped with an AC layer that was in turn buried by varying amounts of sediment (thicknesses of the overlying sediment layer ranged from 30-40 cm). The endpoints were the growth and PCB bioaccumulation in Lumbriculus variegatus and Chironomus riparius. The results indicate that an AC cap can remain effective even once it has been covered with contaminated sediment. This depends, however, on the intensity and depth of bioturbation. With the deeper dwelling L. variegatus present in the test systems, the AC layer was mixed well with the overlying sediment, allowing for a measurable remediation success. With the shallow dwelling C. riparius, this effect could only be observed with minimal sediment coverage of the AC (<5 mm).

382 EcoSafe nanotechnologies for environmental remediation: the NANOBOND project L. Corsi, University of Siena / Physical, Earth and Environmental Sciences; G. Grasso, G. Liberati, University of Siena / Department of Physical, Earth and Environmental Sciences; c. murano, University of Siena; A. Bellingeri, University of Siena / Department of Physical, Earth and Environmental Sciences; a. fiorati, Politecnico di Milano; G. Musso, f. torto, Universita di Torino; C. Punta, Politecnico di Milano

In situ remediation of sludge and dredged harbour sediments is currently highly cost-effective despite an ever increasing number of sites requiring swift treatments to reduce contamination. Therefore there is a urgent need worldwide to identify new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and to enhance future exposure assessments and the health impacts are of concern. With the deeper dwelling L. variegatus, this effect could only be observed with minimal sediment coverage of the AC (<5 mm).

383 Possibility of using a genotoxic tests in planning precise phytoremediation of depleted soils enriched in organic amendments A.O. Murtuza, Czestochowa University of Technology / Department of Infrastructure and Environment; M. Jaskulak, Czestochowa University of Technology / Institute of Environmental Engineering; A. Grobelak, Czestochowa University of Technology / Department of Infrastructure and Engineering

A number of soils at many locations worldwide have become contaminated with a wide range of pollutants due to industrial, residential or agricultural use of both hazardous organic and inorganic chemicals. Increasingly, human industrial activity, our irresponsibility, and impunity have a negative influence on the condition of soils. Thus, the problem of soil contamination, especially with several nanoparticles, and multiple heavy metals remains a matter of concern. Heavy metal pollution is a widespread environmental problem, particularly in urban and industrially developed areas. Heavy metals are toxic to human and other organisms, especially when present in the environment in nanosize. As a challenge, the problem of soil contamination is of great concern both because of the wide range of metal concentrations and the high toxic effects of these substances in the environment. Therefore, the development of an affordable, effective and sustainable method for the remediation of contaminated soils and sediments has become an urgent need. A number of soil remediation technologies have emerged in recent years and recently they have been used to validate the efficacy of phytoremediation and assess ecosecurity (safe-by-design) of use of developed nanomaterials and nanoparticles (ENMP) for environmental remediation, known as nanoremediation, represents a challenging and innovative solution, environmental and human risk assessment associated with the use of ENMP is still a matter of debate. Limited in situ applications to water and soil remediation hindered by lack of data, are often used for extrapolation of impacts and there is a general demand for strategies aimed to fulfill such needs. As the potential and efficacy of nanotechnologies is well established, several drawbacks related to full-scale application should be overcome. In particular, great efforts should be devoted to develop (nano)materials which own eco-friendly features such as limited release and mobility in environmental matrices as well as no toxicity for natural ecosystems. Ecostoxification can be thus used to develop ecofriendly (nano)materials for environmental application and to provide monitoring methods in a weight-of-evidence approach also to support decision-makers. The NANOBOND project (Nanomaterials for Remediation of Environmental Matrices associated to Dewatering) funded in 2015 by POR CReO FESR Toscana 2014-2020, is developing an innovative system for treating contaminated sludge through sediment dredging. For this project, the study was creatively designed, to test the hypothesis that the most effective systems for sediment remediation are those that increase both the rate of removal of contaminants from the sediment and of the remediation of organic and mineral pollutants present in the test systems, the AC layer was mixed well with the overlying sediment, allowing for a measurable remediation success. With the deeper dwelling, this effect could only be observed with minimal sediment coverage of the AC (<5 mm).

384 Sorption of pharmaceuticals in soil systems L. Czub, Environmental Development Department, University of York / Environment Department Pharmacists have been increasingly used worldwide to prevent or treat human and animal diseases and continuously released into the environment (Nicolau et al., 2007). Following treatment, highly mobile and persistent pharmaceuticals tend to reduce contamination. Therefore there is a urgent need worldwide to identify new promising and innovative solutions ensuring a quick and efficient removal of pollutants and appropriate methods for monitoring the effectiveness of remediation strategies and to enhance future exposure assessments and the health impacts are of concern. With the deeper dwelling L. variegatus, this effect could only be observed with minimal sediment coverage of the AC (<5 mm).

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been detected at fairly high levels in aquatic systems (0.33–611 ng/L), terrestrial environments (0.53–340 µg/kg), and in the tissue of organisms (4.6–23.6 µg/kg in crop tissues, 61–127 µg/kg in terrestrial invertebrates) (Chen and Ying, 2015; Kinney et al., 2006; Pan et al., 2014). Long-term exposure to the residues of pharmaceuticals could pose a risk to the ecological system and exert adverse effects on human health via food chain (Carvalho et al., 2014). Adsorption processes have a decisive role for the environmental behaviors and the ultimate fate of pharmaceuticals (Drilla and Lyberatos, 2005). However, relatively a few investigations of the sorption of organic compounds at the group level based on the dissociation degree of molecule in soil have been published so far (Droge and Goss, 2013; Franco and Trupp, 2008; Franco et al., 2009; Kah and Brown, 2007).

The main aim of this study was to explore the effects of properties of the chemical and soil on sorption behaviors of some contaminants in the soil environment. First, sorption behaviors of nineteen pharmaceuticals across four groups (neutrals, strong bases, weak bases, acids) were explored in five test soils. Using the measured sorption coefficients for each group, we evaluated the applicability and accuracy of existing predictive models that have been proposed to predict the sorption behavior of organic chemicals in soil. Finally, Pearson correlation analysis and Principal component analysis (PCA) have been carried out at the group level to systematically assess the potential factors (both soil and drug properties) influencing the sorption behavior of pharmaceuticals in soil and to get better understandings of the sorption mechanisms of different pharmaceuticals in the soil.

385 In vitro and in vivo assays to evaluate chlordecone transfer to animals: interest of soil amendment

M. DELANNOY, URAPFA-INRA / URAPFA INRA; S. Gaspard, Université de Lorraine; COVACHIM; A. Razafitianamaharavo, LIEC Université de Lorraine CNRS; C. Cakir-Kiefer, Université de Lorraine / URAPFA INRA; C. Soligot, E. Montanges-Pelletier, C. Feicht, G. Rychen, Université de Lorraine UL / URAPFA INRA.

Chlordecone (Kepone) (CLD) is a highly persistent pesticide formerly used in French West Indies. Nowadays high levels of this pesticide are still found in soils which represent a subsequent source of contamination for outdoor-reared animals. In that context, sequestering matrices as activated carbons (ACs) or biochars are believed to efficiently decrease CLD transfer to animals. The present study intends to test using 2 distinct in vitro tests prior an in vivo assay the respective efficiency of several biochars and ACs to limit CLD transfer to animals. The Te-PBET and the ISO/DIS 16 751 availability part A protocols were used. In each test amended soils were prepared from a control one (SS) by adding 2% (mass basis) of one of the ACs or biochar. A selection of interesting matrices was realized prior the in vivo part of the study. For each biochar tested, efficiency was measured by animal transfer to contaminated soils. Only treatment groups exposed through amended soil with ACs presented significant decreases CLD availability, bioaccessibility (< 8%). Similar results were found using both in vitro assays. At last, concentrations of CLD in piglets liver and adipose tissue were found significantly lower after exposition to an AC amended soil (p < 0.001). This decrease was particularly high for a coconut shell activated carbon where relative bioavailability was found lower than 3% for both tissues. Finally, a positive correlation was found between environmental availability, bioaccessibility tests and in vivo results. This study leads to conclude that (i) AC introduced in CLD contaminated soil should strongly reduce CLD availability; bioaccessibility and bioavailability (ii) Tested biochars showed no reduction of transfer (iii) availability and bioaccessibility tests could be useful screening tests in order to select the appropriate biochar or AC.

Analysis and Fate of Emerging Contaminants in soils, water and plants under water scarcity (I)

386 Determination of dioxin-like polychlorinated biphenyls in land near the dumps of some settlements of the Republic of Armenia

A. Aleksandryan, Hazardous Substances & Waste Policy Division / Head of Division; A. Khachatryan, Y. Bunyatayn, Environmental Monitoring and Information Center / Division of waste inventory, classification and technology in preparing construction sites.

The sources of environmental pollution with polychlorinated biphenyls along with the energy production/ distribution complex include landfills, many of which do not correspond to environmental requirements and are the only attribute of the “consumer” relationship to nature, thus bringing forth a number of problems and a great danger for the normal functioning of biocenosis. In the present research we used examples of landfills of the Republic of Armenia, where landfills and agricultural residues or water basins near some settlements of the Republic. The following 14 dioxin-like polychlorinated biphenyls (PCBs) were determined in soil samples: congeners NN 77, 81, 105, 114, 118, 123, 126, 157, 167, 169, 180, 185. Quantitative determination was carried out using chromatography with electron capture detectors (ECD) equipped with glass capillary column with stable phase DB-5MS UI and the following parameters: 60 m x 0.250 mm i. d. 0.25 µm. Special attention was paid to the total amounts of polychlorinated biphenyls, as the total amount of these compounds correlates with the hygienic standards, which as such are integral values. In all investigated soil samples dioxin-like PCBs were detected, however, in this case we mainly recorded congeners NN 77, 81, 105, 114, 118, and 123, while NN 169 was determined less frequent and at insignificant quantities. Attention was drawn to the following: – out of 7 randomly selected soil sampling sites, 2 to 3.5 times exceeding of the total/summary standard level was found at four sites; – in all cases, the excess of the standard was due to PCBs NN 81 and 114. Of special attention was the fact that at one of the soil sampling sites (Dilijan Town, Tavush Province of Armenia) along with 3.1-fold exceeding the standard, almost dioxin-like PCBs were found.

387 Associated Health Effects of Veterinary Pharmaceutical Residues in Aquatic Ecosystems around Selected Livestock Agriculture Farms in Western Cape Province

O. Fatoki, Cape Peninsula University of Technology / Chemistry; B. Opeolu, Cape Peninsula University of Technology / Faculty of Applied Sciences; B. Gente, CSIR South Africa; O.S. Olatunj, Cape Peninsula University of Technology / Chemistry.

Livestock farming is a major industry in the Western Cape Province of South Africa and livestock agricultural farms have been suggested to be a major source of pharmaceutical residues in many aqueous matrices, due to their enormous use. Pharmaceutical products such as steroids and non-steroids hormones, antibiotics and non-steroidal anti-inflammatory drugs from agriculture have been indicated to have the potential to show significant endocrine and other health effects. In this study, a High Performance Liquid Chromatography coupled to ultraviolet detector (HPLC-UV-Vis) method was optimized and validated for the detection and separation of the selected pharmaceuticals in effluents for livestock farms with major activity in the study areas. Multi-residue solid phase extraction (SPE) procedure was developed and validated for the recoveries of acetaminophen (AC), diclofenac(DP), salicylic acid (SA), tetracycline(TC), chloramphenicol(CHR), ciprofloxacin(CIP), bisphenol A (BPA), 17β-oestradiol(E2), estrone(EO1) and ivermectin(Iv) from agricultural wastewater using the hydrophilic-lipophilic balance(HLB)-SPE column. Recoveries of the pharmaceuticals from standard aqueous solutions spiked concentrations of between 2 and 10 µg/L were: E2, 76.62 – 85.47 %; AC, 78.29 – 94.34 %; TC, 88.35 – 92.15 %; CHR, 76.62 – 88.35 %; SA, 79.38 – 81.49 %; E3, 85.42 – 92.15 %; BPA, 80.27 – 89.42 %; CP, 76.58 – 90.21 %; DP, 75.46 – 87.55 % and IV, 80.27 – 84.89 %. Various levels of veterinary drugs – AC, < 0.48 – 1.07 µg/L; SA, < 1.37 – 15.49 µg/L; TC, < 3.45 – 4.57 µg/L; CP, 0.45 – 2.46 µg/L and IV, < 1.74 – 1.63 µg/L were detected in the grab water samples. The results of the health risk assessment clearly showed mutagenic activity being observed in samples from sheep and poultry farms. It also showed endocrine activity in the pig farm. The results indicated that making use of the maximum concentration of 17β Estradiol found in the samples, there was a slight risk of developing cancer through accidental ingestion via recreational activities with higher risk if the water was used for domestic purposes without treatment to remove them or if the water was used for irrigation purposes.

388 Characterization of respective contribution of agriculture and urban sources to pesticide contamination of a peri-urban river

V. Duflou, EPOC - UMR 5805 CNRS / UMR 5805 - EPOC LPTC; C. Chollet, J. Cruz, University of Bordeaux / UMR 5805 - EPOC LPTC; D. Granger, M. Capdeville, M. Chambolle, I3RE - Centre de Recherche et Développement SUEZ; H. Budzinski, University of Bordeaux.

Water is nowadays a precious resource on which anthropic pressure increased drastically these last years, due to global lifestyle improvement and the population growth. Pesticides are part of the most prevalent micropollutants in aquatic environments because of their intrinsic toxicity, even at trace-levels. They were firstly used for agricultural yield improvement but they are now used as biocides for the protection of construction materials, wood, textiles, paints, etc., or as veterinary treatment susceptible, and can be discharged in rivers via wastewater treatment plants (WWTP) or Separated Stormwater Overflow (SSO). This multiplicity of uses is linked to high concentrations in rivers, affecting aquatic ecosystems that play role of final receptacle for micropollutants in general. It is thus necessary to consider pesticide impact on the river environment. Theorem of pesticides can be quite expensive and inputs may not be clearly identified or collectible, and as such, their potential risk on the aquatic environment is nowadays considered as an interesting alternative (dose reduction, practice changes, etc.). However this approach requires first of all the identification of uses responsible of inputs, as few information is available nowadays. This study monitored for 4 years a peri-urban continuum formed by a river, SSO and a WWTP also as wastewaters to link uses and presence in environment. Water bodies presented distinct contaminations profiles: rivers were characterized by important concentration of plant protection products while WWTP effluents presented important concentrations of biocides and veterinary molecules which are among the most toxic pesticides. Flux calculation allows identifying agriculture as the major source of plant protection products while WWTP brought the most part of biocides and veterinary products, especially in low-flow period when the WWTP contributes up to 40% to the overall flow of the studied river. Storm sewers had an intermediate status, with less consequents inputs but are still significant because of lack of treatment on these effluents and a potential increase of concentration around the
discharge site. Investigation in the wastewater network identified uses responsible for introduction of some molecules like fipronil or glyphosate which is essential in order to implement actions of reduction at source.

389 Study of bioconcentration of benzophenone-3 in gilt-head Bream and characterization products
H. Ziarrusta, L. Mijangos, University of the Basque country UPV/EHU / Department of Analytical Chemistry; R. Montes, University of Santiago de Compostela; R. Rodil, University of Santiago de Compostela; J. Quintana, University of Santiago de Compostela; E. Anakabe, University of the Basque country UPV/EHU / Organic Chemistry; U. Izagirre, University of the Basque Country UPV/EHU / CBT Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; N. Etxebarria, M. Olivares, O. Zuloaga, University of the Basque Country UPV/EHU / Plentzia Marine Station (PIE-UPV/EHU) & Dep Analytical Chemistry

Benzophenone-3 (BP-3) is a widely used organic UV filter to protect humans and materials from damage by UV irradiation, and owing to its hydrophobic properties, it could potentially bioaccumulate in aquatic biota, including fish (tens to thousands of ng/g). BP-3 can undergo both photodegradation or phase I and phase II metabolism, generating transformation products and metabolites.

Environmental risk assessment approaches often require information on the free concentration in water, biocumulation factors in aquatic organisms, by-products and their toxicity in order to determine the effect of a contaminant on ecosystems. Thus, in the present work, in order to assess the uptake, distribution in different tissues (liver, muscle and gill) and bio- fluids (plasma and bile), metabolism and elimination of BP-3 in gilt-head bream (Sparus aurata), a controlled dosing 14-day experiment was designed at 50 ng/mL concentration level. BP-3 was detected in all the analysed samples, with the highest concentrations at day 14. Bile concentrations were significantly higher in comparison to the rest of tissues/fluids. Since BP-3 is hydrophobic and non-ionizable compound, the lowest concentrations of BP-3 were found in plasma. Although liver tissue (highly lipids) could be an appropriate reservoir of BP-3, the low concentration of non-metabolized BP-3 found in this tissue could indicate a high metabolization activity in liver. And on the contrary, the lack of biodegradation activity in muscle (less lipidic) can explain the second highest concentrations detected, reaching the equilibrium state in the 4th exposure day. In any case, the occurrence of BP-3 in gills suggests that at least part of the uptake occurred through the gills. To completely characterize BP-3 exposure, the analysis performed by means of liquid chromatography – high-resolution mass spectrometry allowed the identification of a broad suite of BP-3-by-products in seawater and fish tissue/biofluids (mainly in bile and liver). By the interpretation of the MS2 spectra, we identified demethylation, hydroxylation and glucuronidation as the main degradation pathways of BP-3. Acknowledgements - This work was financially supported by the Ministry of Economy and Competitiveness through the projects CTM2014-56628-C3-1-R and CTM2014-56628-C3-2-R, Xunta de Galicia (ED431C201736) and FEDER/ERDF. H. Ziarrusta is grateful to the Spanish Ministry of Education and L. Mijangos to the Basque Government for their predoctoral fellowships.

390 Phragmites australis enantioselectively uptake, translocate and degrade the chiral pesticides tebuconazole and imazalil
L. Mijangos, Nottingham School of Animal, Rural and Environmental Sciences; P. Carvalho, Aarhus University, Department of Environmental Science / Department of Environmental Science; M.E. Casas, Aarhus University / Department of Environmental Sciences; U.E. Bollmann, Aarhus University / Department of Environmental Science; C.A. Arias, H. Brix, Aarhus University / Department of Bioscience; K. Bester, Aarhus University / Department of Environmental Science

Phytoremediation is an emerging technology that utilises green plants and their associated rhizosphere microorganisms to clean polluted environmental media. However, the role of plants in removing organic pollutants is still not well understood. Phytoremediation of realistic environmental concentration (10 µg L−1) of the chiral pesticides tebuconazole and imazalil by a wetland plant, Phragmites australis, was investigated. The experiment was carried out in a greenhouse chamber using plants of similar initial size (6.0 ± 0.2 g fresh biomass). The plants were placed in 700 mL glass vessels containing 500 mL hydronopic solution. The pesticides were spiked separately (n=27 for each) in parallel with control samples (n=15). The experiment ran for a period of 24 days. Enantioselective frictions and translocation products (TPs) in both hydronopic growth solutions and plant tissues were measured by HPLC-MS/MS. The uptake, translocation and metabolism of tebuconazole and imazalil inside Phragmites australis were documented for the first time using enantioselective analysis. The pesticides removal efficiencies from water were 96.1% and 99.8%, respectively, by the end of the experiment (day 24). Removal from the solutions could be described by first-order removal kinetics (k=0.14 d−1 for tebuconazole and k=0.31 d−1 for imazalil). Four different processes occurred simultaneously: 1) removal of the pesticides from the hydronopic solution, 2) plant uptake, 3) pesticides translocation in the plant, and 4) degradation within the plant. Tebuconazole and imazalil concentrations inside Phragmites showed a maximum level at day 10 and 5, respectively, followed by a decrease of both compounds concentration. Two TPs of tebuconazole could only be quantified in solution, while two imazalil TPs were quantified in both solution and plant tissue. The uptake of both pesticides was positively correlated with evapotranspiration. The removal of imazalil and tebuconazole from the hydronopic solution was not enantioselective, however, both translocation and degradation inside Phragmites were enantioselective. For tebuconazole, the enantioselective degradation was found in both Phragmites roots and shoots.

391 Effects of the non-steroidal anti-inflammatory ibuprofen on growth and metabolic profiles of Vigna Unguiculata
Y. Pico, University of Valencia / Medicine Preventive; R. Alvarez-Ruiz, University of Valencia; L. Wijaya, A.H. Alfarhan, M. Alyemeni, King Saud University; D. Barceló, IGIQ-CSIIC / Department of Environmental Chemistry

The non-steroidal anti-inflammatory ibuprofen is one of the most frequently detected pharmaceuticals in wastewater treatment plants. Its metabolism has been widely studied in mammals, fungi and microbes. However, little is known on how ibuprofen is metabolized by plants, mostly due to analytical methodology gaps for determining these compounds at low concentration in complex matrices. In this study, the effects of ibuprofen treatment on the growth and its comprehensive metabolic profile in whole plant cultures and seed germinates of Vigna unguiculata were investigated using ultra-high performance liquid chromatography quadrupole time-of-flight mass spectrometry (UHPLC-QToF-MS). To this end, the developed method achieved simultaneous quantitative analysis of ibuprofen, 1 and 2-hydroxyibuprofen and carboxyibuprofen while preserving the instrument ability to get precursor and product ion mass spectra of non-target compounds. The trigger was the precursor ions to reach 100 cps intensity. Seeds of V. unguiculata were obtained from Gizaan area of Saudi Arabia, were germinated in Petri ‘plates’ or sown in pots and were grown in a growth chamber (temperature 26 ºC) for 5 days. Forty-six metabolites of ibuprofen in V. unguiculata were successfully identified. The 1-hydroxy and 2-hydroxy ibuprofen were confirmed and quantified using their analytical standards. The structures of the other metabolites were proposed using high resolution mass spectrometry (HRMS) and high resolution tandem mass spectrometry (HRMS/MS) data. In particular, the combination of mass accuracy and the fragmentation patterns of metabolites and parent compounds allowed proposing plausible structures for each metabolite. Six hexosides were already reported in study on Phragmites australis and Lemma gibba. Thirty-eight of the identified metabolites were already reported in a study on cell cultures of A. thaliana and 9 of them (conjugates of ibuprofen or hydroxyibuprofen with amino acids) are, up to our knowledge, reported for first time in plants.

Prioritisation and Intelligent Testing of Pharmaceuticals in the Environment (I)

392 Environmental Risk Assessment of Active Pharmaceutical Ingredients used in Human Medicinal Products: Europe-wide Variation in Risk Quotient
J. Snapc, AstraZeneca UK Ltd. / AstraZeneca Global Environment; S. Owen, AstraZeneca / Safety Health Environment; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; B. Verbruggen, University of Exeter; E. Gunnesson, University of Exeter / Biosciences

This presentation will describe the total consumption-based environmental risks posed by 130 human medicinal products and the impact of mode of action, lipophilicity and dilution on these risks. In accordance with Article 8(3) of Directive 2001/83/EC, as amended, a new marketing authorisation application shall be accompanied by the evaluation of the potential environmental risks posed by the human medicinal product. These environmental risk assessments (ERAs) estimate the potential environmental impact on a product-by-product basis rather than a substance-by-substance basis. In the cases where an active pharmaceutical ingredient (API), or substance, is used to treat multiple clinical diseases, there is the possibility to under-estimate the impact of impurities. The European Medicines Agency (EMA) guidance for the environmental risk assessment of human medicinal products has been in place now for over 10 years. The introduction of this guidance marked a step change in the ERA requirements for human medicinal products, with a shift from short-term acute to long-term chronic environmental effects assessments, and tailored ERAs for active pharmaceutical ingredients (APIs) with suspected or known reproductive effects. To determine the total substance or API risk, we have: (i) identified and collected definitive published no observed effect concentrations (NOECs) for available APIs (excluding anti-infectives and anti-parasitic products); (ii) collated human consumption data for each of these APIs in European Countries where these products are licenced for use; (iii) conducted a worst case exposure assessment (predicted environmental concentration (PEC)) and estimated margin of safety (MOS=100, 800, 1200, 1600) and analysed the variability in the risk quotients (RQs) for each API across Europe and (v) looked at the impact of country-specific dilution factors applying the 5th percentile and
393 Estimation and prioritization of hospital API emissions

A. M. Ragas, Radboud University / Department of Environmental Science; C. van Lierop, M. Galpen, K. Tiptater, Radboud University; R. Oldenkamp, Radboud University / Environmental Science, Department of Environmental Science

Hospitals constitute an important source of APIs, particularly for substances like antineoplastics and contrast agents. Measuring these emissions and their impacts is possible, but is very time-consuming and costly. The main aim of the present study was to develop an approach for estimating hospital API emissions based on hospital purchase data and to prioritize these emissions based on potential environmental impact. A model was developed to estimate the API loads reaching the hospital sewer system. The model accounts for the return of unused APIs, route-specific excretion by patients, non-patient API use (e.g., personnel) and off-side emissions. The model was operationalized for 16 APIs emitted by two academic hospitals in the Netherlands. Model predictions were validated based on measurements of APIs in the sewer system using passive samplers with speediQ® as absorbent. The samplers were deployed over a 10-12 day period and analyzed in the laboratory using LCMS. Most of the estimated loads were within a factor of 10 of the measured loads. On average, estimations for Hospital 2 were more accurate than for Hospital 1, which was probably due to the use of monthly purchase data and some other small model improvements implemented for Hospital 2. APIs which are typical for hospitals (e.g., antineoplastics and contrast media) were relatively well predicted. The prioritization of the APIs based on environmental impact was substantially influenced by the availability and interpretation of toxicological data. Dichlofenac ranked highest, but this ranking was determined by one particular toxicity study of which the validity is being disputed. Ciprofloxacin consistently ranked high, and to a lesser extent also paracetamol and metoprolol. Azithromycin and isoprenal also ranked relatively high, but only limited toxicity data were available for these substances, resulting in large safety margins.

394 Development and validation of a model to predict concentrations of human APIs in European surface waters

R. Oldenkamp, S. Hoeks, V. Barbarossa, M. Cengic, Radboud University Nijmegen / Department of Environmental Science; L. Carter, University of York / Environment Department; E. E. Burns, University of York / Chemistry; J. Wilkinson, The University of York / Natural and Built Environments; A. Boxall, University of York / Environment Department; A. M. Ragas, Radboud University / Department of Environmental Science

Active Pharmaceutical Ingredients (APIs) are consumed in large quantities, and end up in the environment as a result of not being degraded completely during passage through the human body and wastewater treatment plants (WWTPs). Although reported concentrations are generally low, adverse ecological effects caused by some human APIs are plausible considering their specific modes of action and high potential. Consequently, the issue of human APIs in the environment has been acknowledged as an emerging environmental problem requiring scientific and regulatory attention. A crucial step in environmental risk assessment of APIs is the estimation of their environmental exposure potential. Since there are currently more than 4,000 different human APIs in use, monitoring individual APIs is practically impossible. The aim of the present study was to develop and validate a model for the estimation of the environmental fate of APIs. The model included the extensive location-specific information about European WWTPs, the flexibility in modeling Europe’s hydrology and accounting for ionizing properties of APIs. The model was validated using several studies reporting API concentrations in the Rhine basin. API-specific data and characteristics (e.g. physicochemical properties and consumption data) were obtained from the literature. Site-specific and API-specific measurements were directly compared to estimated water concentrations at the relevant locations in the river network. From the results shown for the Rhine basin and preliminary results of some additional basins, it can be concluded that estimations can be made with great spatial and quantitative accuracy. However, model performance depends on factors such as the allocation of country-specific consumption over relevant WWTPs, accuracy of the estimated hydrology, provided consumption data and API-specific characteristics.

395 Occurrence and fate of the antiabetic metformin and its transformation products

S. Tüerler, Environmental Analytical Chemistry, Center for Applied Geocience, University of Tuebingen / Analytical Environmental Chemistry; C. Zwiener, Environmental Analytical Chemistry, Center for Applied Geocience, University of Tuebingen / Geosciences

Effluents of municipal wastewater treatment are major entry pathways for pharmaceuticals and their transformation products (TPs). A wide-spread compound is the antiabetic drug metformin (MF) with its well-known main metabolite guanyl urea (GU). GU is formed in WWTPs. So far, no other TPs of metformin are reported in the water cycle. In this study, electrochemical experiments for simulation and identification of potential new TPs of MF were performed. In addition we investigated the occurrence and fate of MF and its TPs in WWT and surface water. Analysis was performed by LC-high-resolution-mass-spectrometry (HRMS) using HILIC (hydrophilic interaction chromatography) in quadrupole-time-of-flight mass spectrometry (QTOF-MS). Four TPs of MF have been identified after electrochemical degradation. The proposed structures are 4-amino-2-mimino-1-methyl-1,2-dihydro-1,3,5-triziane (4,2-AMT), 2-amino-4-methylamino-1,3,5-triziane (2,4-AMT), 2-diamino-1,3,5-triziane (2,4-DAT) and methylbiguanide (MBG). The mass error was below 3 ppm for all 4 TPs. However, the well-known TP GU could not be formed electrochemically. The TPs found are similar to those of a former study using gamma radioisotopes (Collin et al. 2004). 24-hour mixed samples of wastewater in Southwest Germany were obtained for 7 consecutive days. Elimination of MF was 92 % at an average influent concentration of 24 µg/L. GU concentrations were in the inffluents between 66 and 640 µg/L and in the effluents between 60 and 386 µg/L. A plausible reason for the occurrence and relatively high concentrations of GU compared to MF could be the formation of GU already in parts of the sewer system. The following oxidation products of MF have been detected for the first time: 2:4-DAT, MBG and 2,4-AMT. The concentrations of MBG ranged between 40 and 122 ng/L. For the other TPs no authentic standards were available, however TPs 2,4-DAT and 2,4-AMT showed similar attenuation as to verify if they are PBT-relevant metabolites, which implies their formation during WWT. 3 grab samples of surface water affected by waste water showed relatively high MF (between 100 and 470 ng/L) and GU (between 3700 and 4500 ng/L) concentrations. MBG was in the range between 10 and 30 ng/L. In addition, 2,4-DAT was detected. Its response was in all three samples about 40 % of the response in the WWT effluent samples. The study is performed within the project “Effect-Net”, funded by the Ministry for Science, Research and Art, Baden-Württemberg.

396 Development of biotransformation half-life QSARs and PBT assessment of pharmaceuticals in European surface waters

E. Papa, A. Sangion, University of Insibria / Department of Theoretical and Applied Sciences (DiSTA); J. A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; P. Gramatica, University of Insibria / Department of Theoretical and Applied Sciences (DiSTA)

640 pharmaceuticals and Personal Care Products (PPCPs) were of particular interest for the environment since it has been demonstrated that many of them are persistent or “pseudo-persistent” due to their extensive use and continuous emission. They have potential for bioaccumulation in organisms of different trophic levels and exposures to PPCPs can result in acute and chronic effects in target and non-target organisms. Guidelines for Environmental Risk Assessment of human medicines require, in the first step, a preliminary phase to verify if a PPCP is not a PBT-relevant metabolite Persistent, Bioaccumulative and Toxic (PBT). Biotransformation has been recognized as a key determinant for bioaccumulation assessment for many chemicals. This study addresses the development of QSAR models for the prediction of in vivo whole body human biotransformation half-lives measured or empirically-derived for over 1000 PPCPs, mainly represented by pharmaceuticals. First, we performed with data for 129 compounds with half-lives (HLs) in human adults and the derived whole body in vivo biotransformation half-life (HLv) were used to develop HL-QSAR models based on theoretical molecular descriptors. The statistical parameters calculated for the models reflect the good ability to fit the data in the training sets (R² range: 0.77 – 0.80) the robustness (QLOO and QLOSE range: 0.77 – 0.79) and the external predictivity (Qvave: range: 0.75-0.79; CCC range: 0.86-0.87). These QSARs were used, in combination with literature models for the prediction of biotransformation half-lives in fish, to refine the screening of the potential PBT behaviour of over 1300 PPCPs. Principal Component Analysis (PCA) was applied to combine experimental biotransformation half-life data and reliable QSAR-predictions to assess biotransformation process in multiple species (i.e. fish or human). This combination of models is helpful to highlight the problematic PPCPs, according to their slow or fast potential for biotransformation, i.e. 22 slowly biotransformed compounds were highlighted as potential PBTs, 18 compounds formerly detected as PBTs resulted easily metabolized, while the PBT behaviour of 59 PPCPs may have been underestimated. This study highlights the importance of biotransformation for the refinement of screening level assessments of Bioaccumulation and Bioconcentration behaviour (i.e. potential PBT behaviour) of chemicals and shows how in silico approaches can be efficiently integrated to support these assessments.

397 Predicting spatial and temporal variability in internal concentrations of antimyrtine in invertebrates within an urban catchment

A. Giorgis, University of York; A. Agatz, IBACON GmbH / Environment Department; L. Carter, University of York / Environment Department; E. Burns, University of York; M.D. Nuñez, University of York / Environment; J. Wilkinson,
Plants: predicting and assessing direct, indirect effects and recovery of plants from chemical stress

398 Waterplants in Risk Assessment - Selection of Potential Plant Species - Impact of Different Test Guidelines

G. Gonsior, Eurofins AgroScience Services Ecotoxic GmbH

When results of standard laboratory tests show an unfavorable high risk, aquatic higher tier tests are needed to reduce uncertainties. In case there is a high risk for aquatic plants additional species could help to reduce these uncertainties for risk assessment by performing Species Sensitivity Distribution (SSD) tests. However, it is not clear which criteria are used for selection of test species and which guideline is most appropriate for adapting non-standard species. Most tests were performed based on the Lemna guideline OECD 221, the two Myriophyllum spicatum guidelines OECD 238 and OECD 239, the ASTM E1913-04(2012) for Myriophyllum sibiricum, Sediment contact test with Myriophyllum aquaticum (ISO/DIS 16191) and the principles of the method proposed by the AMRAP (Aquatic Macrophyte Risk Assessment Protocol) Grass (2007). Specifically, we analyzed to which extent the two test guidelines were in good agreement. Predictions of internal concentrations of amitriptyline in aquatic plants is useful for adaption to non-plants. For example, the recovery of plants from chemical stress depends on the ionisation state of the molecule which is driven by the pH of the surrounding medium. Recently a toxicokinetic modelling approach has been proposed to account for this variation in pH. Here, we present this modelling approach to derive toxicokinetic parameters from laboratory experiments for the accumulation of amitriptyline, an antidepressant compound, in *Lemna* variegata. Toxicokinetic (TK) parameterisation and the underlying experiments involved the measurement of uptake and accumulation of *L. variegata* at four medium pHs (5.5, 7, 8, 9). To simulate accumulation at the landscape scale, we used the generated toxicokinetic parameters in combination with measured monthly concentrations of amitriptyline in river water and associated water pHs obtained from a one year long monitoring study along the two rivers (rivers Ouse and Foss) in the City of York, UK. Data from the experiments at pH 5.5 and 9 were used to successfully parameterise the TK model. Data for two pH values (pH 7 and 8) were then used to predict uptake and depuration rates for the neutral and ionised species of the API. Use of the derived rate constants to simulate the accumulation at the two intermediate pHs revealed that the approach underpredicts the actual accumulation by a factor of 2-4. Predictions of internal concentrations of amitriptyline in *L. variegata* varied by 6 times across the monitoring sites and over the year. Generally, internal concentrations were predicted to be much higher for the river Foss (which had a concentration range of 0.52-2.9 pmol/l and a pH range of 7.6-8.45) than the river Ouse (which had a concentration range of 0.29-2.95 pmol/l and a pH range of 7.4-8.44) and accumulation increased during the course of the year. Even though the model underestimated the internal concentrations by a factor of 2 and in laboratory experiments conducted at pH 7 and 8 respectively, the general approach worked reasonably well to obtain internal concentrations. This study revealed important insights into the accumulation of pharmaceuticals by non-target organisms which will help to fully understand the risks posed by pharmaceuticals at the catchment scale.

399 Applying the EFSA Scientific Opinion on NTTP: Testing non-crop species and the reproductive capability of selected species under greenhouse conditions

T.A. Springer, EAG Laboratories / Specialist Projects & Histology; H.O. Krueger, EAG Laboratories / Aquatic, Plant and Insect Toxicology; J.W. Green, DuPont / Data Science and Informatics

The University of York / Natural and Built Environments; R. Ashauer, University of York / Environment Department

The majority of active pharmaceutical ingredients (APIs) currently in use are ionisable and may become charged at environmentally relevant pHs. Previous research has shown that the accumulation of a molecule in aquatic invertebrates depends on the ionisation state of the molecule which is driven by the pH of the surrounding medium. Recently a toxicokinetic modelling approach has been proposed to account for this variation in pH. Here, we present this modelling approach to derive toxicokinetic parameters from laboratory experiments for the accumulation of amitriptyline, an antidepressant compound, in *Lemna* variegata. Toxicokinetic (TK) parameterisation and the underlying experiments involved the measurement of uptake and accumulation of *L. variegata* at four medium pHs (5.5, 7, 8, 9). To simulate accumulation at the landscape scale, we used the generated toxicokinetic parameters in combination with measured monthly concentrations of amitriptyline in river water and associated water pHs obtained from a one year long monitoring study along the two rivers (rivers Ouse and Foss) in the City of York, UK. Data from the experiments at pH 5.5 and 9 were used to successfully parameterise the TK model. Data for two pH values (pH 7 and 8) were then used to predict uptake and depuration rates for the neutral and ionised species of the API. Use of the derived rate constants to simulate the accumulation at the two intermediate pHs revealed that the approach underpredicts the actual accumulation by a factor of 2-4. Predictions of internal concentrations of amitriptyline in *L. variegata* varied by 6 times across the monitoring sites and over the year. Generally, internal concentrations were predicted to be much higher for the river Foss (which had a concentration range of 0.52-2.9 pmol/l and a pH range of 7.6-8.45) than the river Ouse (which had a concentration range of 0.29-2.95 pmol/l and a pH range of 7.4-8.44) and accumulation increased during the course of the year. Even though the model underestimated the internal concentrations by a factor of 2 and in laboratory experiments conducted at pH 7 and 8 respectively, the general approach worked reasonably well to obtain internal concentrations. This study revealed important insights into the accumulation of pharmaceuticals by non-target organisms which will help to fully understand the risks posed by pharmaceuticals at the catchment scale.

400 Predicting plant community level effects of herbicides based on monoclone dose-responses: Testing the plant community model IBC-grass with experimental data

G. Gonsior, University of Potsdam / Plant Ecology and Nature Conservation; S. Heinicke, Bayer Ag / Effect modelling; C. Milian, Bayer CropScience AG / Ecotoxicology; T. Preuss, Bayer Ag / Environmental Safety; F. Jeltsch, University of Potsdam

G. Gonsior

Bayer Ag / Effect modelling; C. Mihan, Bayer CropScience AG / Ecotoxicology; T. Springer, EAG Laboratories / Specialist Projects & Histology; H.O. Krueger, EAG Laboratories / Aquatic, Plant and Insect Toxicology; J.W. Green, DuPont / Data Science and Informatics

The majority of active pharmaceutical ingredients (APIs) currently in use are ionisable and may become charged at environmentally relevant pHs. Previous research has shown that the accumulation of a molecule in aquatic invertebrates depends on the ionisation state of the molecule which is driven by the pH of the surrounding medium. Recently a toxicokinetic modelling approach has been proposed to account for this variation in pH. Here, we present this modelling approach to derive toxicokinetic parameters from laboratory experiments for the accumulation of amitriptyline, an antidepressant compound, in *Lemna* variegata. Toxicokinetic (TK) parameterisation and the underlying experiments involved the measurement of uptake and accumulation of *L. variegata* at four medium pHs (5.5, 7, 8, 9). To simulate accumulation at the landscape scale, we used the generated toxicokinetic parameters in combination with measured monthly concentrations of amitriptyline in river water and associated water pHs obtained from a one year long monitoring study along the two rivers (rivers Ouse and Foss) in the City of York, UK. Data from the experiments at pH 5.5 and 9 were used to successfully parameterise the TK model. Data for two pH values (pH 7 and 8) were then used to predict uptake and depuration rates for the neutral and ionised species of the API. Use of the derived rate constants to simulate the accumulation at the two intermediate pHs revealed that the approach underpredicts the actual accumulation by a factor of 2-4. Predictions of internal concentrations of amitriptyline in *L. variegata* varied by 6 times across the monitoring sites and over the year. Generally, internal concentrations were predicted to be much higher for the river Foss (which had a concentration range of 0.52-2.9 pmol/l and a pH range of 7.6-8.45) than the river Ouse (which had a concentration range of 0.29-2.95 pmol/l and a pH range of 7.4-8.44) and accumulation increased during the course of the year. Even though the model underestimated the internal concentrations by a factor of 2 and in laboratory experiments conducted at pH 7 and 8 respectively, the general approach worked reasonably well to obtain internal concentrations. This study revealed important insights into the accumulation of pharmaceuticals by non-target organisms which will help to fully understand the risks posed by pharmaceuticals at the catchment scale.
complicated by seasonality, changes in nutrients, recolonization, competition, and other factors. Terminology and methodology need to be standardized if the concept of recovery is incorporated into evaluations of chemicals. For some plant types and properties, recovery is contingent upon the timing and duration of exposure and extent of injury. In such cases, the definition of recovery must specify timing and duration of exposure in the operational definition. Examples of recovery in laboratory studies for algae, lenna, and myriophyllum studies will be presented as well as results from mesocosm studies. Statistical procedures and experimental designs will be presented for these examples and interpretation of results will be discussed.

402 Aquatic primary producers and plant protection products: endpoints and level of protection achieved in the first tier of the risk assessment scheme

S. Duquesnes, UBA, Federal Environment agency; L. Hønnemann, S. Matezki, M. Solé, K. Swarowsky, German Environment Agency UBA; J. Wogram, German Environment Agency UBA / Department IV - plant protection products

In the risk assessment for aquatic primary producers exposed to plant protection products (PPP), the endpoint (EP) corresponding to 50% inhibition of growth (EC50s) is used in the first tier. The EC50s can be expressed as inhibition of the average specific growth rate (ErC50) or as reduction in biomass, calculated from yield (EyC50) or as the integral under the growth curve (EbC50). The lowest available EP among ErC50, EbC50 or EyC50 used to be selected to derive safe concentrations of pesticides in surface water bodies. It is now recommended [1] to use ErC50s since it is a more robust endpoint. However, it is not yet clear if the protection level achieved is sufficient. This work shows that this new approach (i.e. selecting ErC50) shifts thus the level of conservatism of a factor of 6.9 and 3.5 for algae and Lemna sp., respectively. It also shows that the level of protection achieved for primary producers becomes insufficient in 59% of the cases, since the Tier 3 Regulatory Acceptable Concentrations (RACs) from micro-/mesocosm studies (considered as surrogate reference Tier) are lower than the Tier 1 RACs from standard toxicity tests. The results demonstrate that the intended level of protection is currently reached in only 41% of the cases versus 69% of the cases previously. In addition, this work explores which combination of EC50 (E(C50, ss) etc.) and assessment factor would ensure an adequate level of protection. Recommendations are provided for an optimization of the risk assessment.

403 Poster spotlight: WE152, WE153, WE154

Environmental monitoring of contaminants using terrestrial ecological biomonitor

404 Persistent Organic Pollutants in Germany: Results from the 2015/2016 moss and tree needle sampling

A. Dreyer, Eurofins GfA GmbH / Air Monitoring; S. Nickel, University of Vechta / 2; J. Koschorreck, Umweltbundesamt; W. Schröder, University of Vechta / 2

This presentation aims at reporting on the determination of selected POPs in eight moss samples from Germany within the framework of the 2015 European moss survey and comparing the respective results with such derived for leaves and needles collected for the German Environment Specimen Bank (ESB). The moss samples were collected in areas located in the vicinity of tree sampling sites from the ESB in fall 2016. Deciduous tree leaves and coniferous shoots were sampled in 2015 or 2016 according to the ESB protocols. Overall, 17 polychlorinated dibenzo-furans (PCDD/F), 18 polychlorinated biphenyls (PCB), 16 polycyclic aromatic hydrocarbons (PAH), 17 perfluoroalkyl substances (PFAS), 3 isomers of hexabromocyclododecane (HBCD), 7 polybrominated dibenyl ethers (PBDE), 24 polybrominated diphenyl ethers (PBDE), and 21 alternative halogenated flame retardants (HFR) such as Dechlorane Plus were determined. Except for PBDEs and PFASs, POPs of all substance groups could be quantified, although to different extents. Concentrations of individual PAHs and HFRs were in the same order of magnitudes as those observed in coniferous shoots or deciduous tree leaves from nearby located areas. Highest levels of PCDD/F, dD-PCBs, HBCD and PAH in moss were observed at sites close to the Belauer See (Northern Germany, agricultural land-use) and the Harz National Park. Concentrations of PBDEs were highest at the two sampling sites in Saarland (conurbation) and at the Harz site. Concentrations for Dechlorane Plus were highest at the Harz site followed by sites located at Solingen (forestry) and Scheerzen (agricultural) and were lowest at the site in the Halle-Leipzig conurbation. Thus, surrounding land-use does not seem to be the (only) driving force determining the POPs burden in moss samples. PBDE moss concentrations observed in this study were similar to those observed at background sites in Spain and lower than those of background/remote sites in Norway. Concentrations of Dechlorane Plus were more than a factor of 100 higher than moss concentrations reported for Svalbard (Arctic Norway).

Mapping percentile statistics of element concentrations in moss collected from 1990 to 2015 in forests throughout Germany

W. Schröder, S. Nickel, University of Vechta / 2

Monitoring and mapping of atmospheric deposition can be achieved by use of chemical transport models, technical sampling devices and bioaccumulators such as moss. Within the European moss survey programme, since 1990 every five years moss have been sampled at 7500 sites and more. Data on the content of heavy metals (since 1990), nitrogen (since 2005), and persistent organic pollutants (since 2010) in moss specimens, quality control and statistical evaluation was conducted according an harmonized methodology [1]. Mapping the percentile statistics of heavy metals and nitrogen concentration in moss sampled in forests across Germany is the focus of this paper. Thereby, element- and survey-specific as well as heavy metals and surveys integrating statistical evaluations and GIS-mapping were performed. Cr, Hg, Sn and Zn show, contrary to Fe and Pb, no constant decrease of element concentrations, but an intermediate increase between 2000 and 2005, which did not continue until 2015. Al, As, Cd, Cu and V stagnated between 2000 and 2005. Hg from 2005 to 2015. Therefore, Cr, Sn and Zn will be focussed in this paper together with Cu, Hg, Pb and N which are of priority according to the Convention on Long-range Transboundary Air Pollution. Survey-specific statistical analyses corroborate that the spatial patterns of element concentrations in moss are changing across time. The-long term information on the percentile statistics of bioaccumulation of atmospheric deposition in moss is essential for further scientific evaluation as well as for measurements and reporting of nature protection and environmental management.


406 Heavy metal and nutrient concentrations in different age classes of holm oak leaves and pine needles - a reference for biomonitoring and geochemistry

J. Franzinger, A. Fangmeier, University of Hohenheim / Institute of Landscape and Plant Ecology; L. Paoli, University of Siena / Dept. of Life Sciences; S. Ancora, University of Siena / Physical sciences, Earth and environment; S. Schlosser, University of Hohenheim / Core Facility Hohenheim; E. Meneghini, University of Siena / Dept. of Environmental, Earth and Physical Sciences

Passive biomonitoring is being used for many years to assess changes in the state of the environment. Existing programs make use of international, national, regional and local monitoring networks addressing the effects of the widespread deposition of air pollutants and eutrophying compounds and the accumulation of these in e.g. forests and agricultural ecosystems. However, plants differ in the uptake of essential and non-essential inorganic elements and organic pollutants and the accumulation varies over time and space mainly due to the different geochemistry and climates in different regions. Here we report on the results of a biomonitoring study using holm oak (Quercus ilex L.) and two pine species (Pinus nigra J. F. Arnold and P. Pinaster Ait.), i.e. evergreen deciduous coniferous trees to monitor metal deposition as moss and needles were sampled at different locations in the Mount Amiata and Colline Metallifere region in spring 2017 and the samples consisted of three age classes. While half of the analyses were performed on unwashed samples, the other half rested on samples that were thoroughly rinsed with deionized water prior to the analyses. ICP-MS, ICP-OES and CNS elemental analyses were applied for the determination of Cu, Sh, Al, Ba, Cr, Ni, V, Fe, Hg, K, Mg, As, Pb, Cd, Zn, Ca and Mn. From the significant differences in element concentrations and patterns between the tested species, regions and sites, differences between the washed and unwashed samples was less pronounced indicating that deposition of dust does not play a great role in the area. On the other hand, our preliminary analyses showed significant differences in elemental concentrations between different aged trees, which relate to the availability, translocation, accumulation or generation of plant essential and non-essential elements. Multi-element analyses and nutrient ratios can serve to differentiate between the characteristic geochemical and species-specific patterns and the positive derivation from these patterns points to the exceedence of element levels due to pollution and eutrophication.

Biomonitoring in post-mining areas serves to identify pollution hotspots and can be used as a key component in controlling the success of land reclamation and for agriculture.

407 Examining historical trends in diet and contaminant exposure in bats using butanoic acid deposits from Jamaica

L. Gallant, University of Ottawa / Department of Biology; C. Grooms, Queens University; I.E. Kimpe, University of Ottawa / Department of Biology; J.P. Smol, Queens University / Biology; W. Bogdanowicz, Museum and Institute of Zoology;
J.M. Blais, University of Ottawa / Biology

Bats are excellent ecological indicators owing to their long life span, global distribution, and predictable responses to environmental stressors. Bats play important roles in pollination, seed dispersal, and insect population control and thus it is important to determine whether bat diets change over time as a result of exposure to contaminants such as metals. Bat guano deposits are of particular use as they may serve as historical archives for the cave environment and preserve stable isotopes and metals which allow for the determination of historical exposure to contaminants as well as any fluctuations in diet. This research provides the rare opportunity to examine two bat guano deposits from Jamaica: bat guano was heavily mined for gun powder and fertilizer and as such, there are few bat guano deposits that have been unaltered by human exploration or exploitation. The objective of this research is to reconstruct historical changes in diet in the face of contaminant exposure to bats in order to better understand how anthropogenic activity affects these high trophic level mammals. We constructed the 210Pb, 137Cs, and 14C dating profiles in both bat guano deposits: this revealed that one of the deposits is over 3,000-years-old. We constructed the δ34S-N, δ34C, and δ39Si profiles in order to determine the long-term dietary trends in the bat guano deposits.

Preliminary results suggest that the 3,000-year-old bat guano deposit is tracking a change in stable isotopes associated with the agricultural history of Jamaica, specifically, the introduction of: nitrogen fertilizers, the Bordeaux mixture, and sugar cane. We also examined the sterol profiles in the bat guano deposits for the purpose of determining more specific dietary information. Recent peaks in cholesterol and stigmastanol, for example, could be evidence of fluctuations in feeding habits (< 1°/oo, vehicle) or to 100 µg/L DCF. Analytical methods relating to this experiment was carried out whereby marine mussels were exposed for 7 days to PFAS = 21 ng/g wm), which is Pb/Na of 0.32 ng/g wm (wet mass) for North (0.9 ng/g wm for South). Adult dragonflies are aerial predatory arthropods that occur globally. However, no research on adult dragonflies as potential indicators of environmental metallicity and contaminant exposure has been conducted yet. Perfluorooctanesulfonic acid (PFOS) occurred at similar concentrations at all six sites, while quantifiable, but PFOS dominated in the Southern sites. The highest median concentration was from Bloemond Dam (PFAS = 21 ng/g wm), which is known to be polluted by PFOS. The results also indicated that all species of dragonflies, regardless of body size and habitat type preference are suitable indicators of environmental metallicity. Sites located near wastewater treatment plants had elevated concentrations associated with mining and industries. Dragonflies from sampling sites near potential pollution sources that seemed to have consistent PFAS and metal concentrations than those located farther from pollution sources. All substances, except for North, and 9.3 ng/g wm for South). All substances, except for North, and 9.3 ng/g wm for South). All substances, except for North, and 9.3 ng/g wm for South). All substances, except for North, and 9.3 ng/g wm for South). All substances, except for North, and 9.3 ng/g wm for South).

403 Bioavailability of Arsenic and Antimony co-contamination to vegetable crops in agricultural soils

L.P. Fugelvand, University of Wollongong / School of Chemistry; A. Holland, La Trobe University / Centre for Water, Land and Atmospheric Research; A. Singh, School of Environmental and Physical Sciences, Antimony (Sb) is an emerging contaminant that is associated with behavior in a similar way to arsenic (As). Sb and As occurring because of mining. Bioaccumulation and phytotoxicity of As is well studied, but there is little evidence on Sb and its interactive effects with As. Metalloid accumulation in agricultural soils may present health risks and hazards to humans and ecosystems through direct ingestion or contact with contaminated soil and food, a reduction in food quality (and marketability) via phytotoxicity and reduction in land usability for agricultural production. Plant bioassays allow inferencing the potential toxicity of contaminants. The phytotoxicity in the contaminated soils is governed by the bioavailability of the contaminant, which in turn is influenced by soil physical and chemical characteristics, contaminant speciation and the species of plant. However, it is still unclear the impacts of ageing of agricultural lands on the co-contamination of As and Sb on alternation of crops. Our study evaluated the potential use of vegetable crops to identify and assess the bioavailability and toxicity of As and Sb in co-contaminated soils using bioassays. Water spinach and choy sum are herbaceous leafy vegetable belonging to the morning glory (Convolvulaceae) and mustard (Brassicaceae) families, respectively. Our study compares the soil characteristics in terms of total and bioavailable metal fractions with plant accumulation and toxicity data. Plant toxicity parameters (tissue biomass and lengths) were used to evaluate impacts of contaminant exposure on plant productivity. This information was used to understand the tolerance of plants grown in As and Sb contaminated soils, and the risks associated with As and Sb co-contaminated soils. This was done as single element and mixed metal exposures. Test soils were silty sand and slightly acidic. Bioavailable As and Sb in soils increased proportionally with total metal concentration. A clear increase in the tissue accumulation of As and Sb was observed with increasing bioavailable metal fraction for both individual (As and Sb) and combined (As+Sb) treatments. Vegetative productivity decreased when grown in As only and As+Sb combined contaminated soils. Sb contamination in agricultural soils poses a greater human health risk and hazard than As only and As+Sb co-contamination, because Sb accumulates in edible crops with no observed phytotoxicity or reduction in the vegetable productivity.

Systems ecotoxicology: application of OMICS data across multiple levels of biological organization in research and risk assessment (I)

140 Transcriptomic responses of the endangered freshwater mussel Margaritifera margaritifera to trace metal contamination

A. Lazzari, L. Thiébault, Université de Bretagne / LEMAR UMR 6539 CNRS/UBO/IIRD/ifremer; C. Kloppe, INRA Institut National de la Recherche Agronomique / Plate-forme bio-informatique Genotoul, Mathématiques et Informatique Appliquées de Toulouse; J. Bellec, Université de Bretagne / LEMAR UMR 6539 CNRS/UBO/IIRD/ifremer; P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; M. Baudrin, University of Bordeaux / UMR EPOC CNRS 5805. The freshwater pearl mussel Margaritifera margaritifera is one of the most threatened freshwater bivalves worldwide. In this study, we aimed (i) to study the processes by which water quality might affect freshwater mussels in situ and (ii) to provide insights into the ecotoxicological significance of water pollution to natural populations in order to provide necessary information to enhance conservation strategies. Margaritifera margaritifera specimens were sampled in two close sites located upstream or downstream from an illegal dumping site. The main transcriptome of these animals was assembled and gene transcription determined by RNA-seq. Correlations between transcription levels of each single transcript and the bioaccumulation of trace metals, age (estimated by scleroclithology) and condition index were determined in order to identify genes likely to respond to a specific factor. Amongst the studied metals, Cr, Zn, Cd and Ni were the main factors correlated with transcription levels, with effects on translation, apoptosis, immune response, response to stimulus and transport pathways. However, the main factor explaining changes in gene transcription appeared to be the age of individuals with a negative correlation with the transcription of retrotransposons-related genes. To investigate this effect a metatranscriptome of mussels was analyzed and could be classified into 3 age classes. In young, middle-aged and old animals, transcription levels were mainly explained by Cu, Zn and age, respectively. This suggests differences in the molecular responses of this species to metals during its lifetime that must be better assessed in future ecotoxicology studies.

411 LC-HRMS based-metabolomics to highlight biodiversity products and effects of diloofenac in Mytilus galloprovincialis

F. Courant, Université de Montpellier - UMR 5690 Hydrosciences / UMR Hydrosciences; B. Bonnefille, H. Fenet, Université de Montpellier / UMR Hydrosciences; E. Gomez, Université de Montpellier, Hydrosciences Montpellier UMR 5690 / UMR Hydrosciences. Diloofenac (DCF) has become a major contaminant of interest as shown by its inclusion in the EU Water Framework Directive (2015/495/EC). However, relatively little is known regarding its biotransformation and effects in the Mediterranean mussel. Environmental metabolomics affords several advantages to study both topics. The metabolome relates essentially to i) the "endometabolome", compounds by endogenous metabolites, and to ii) the "exometabolome", in reference to xenobiotics and their biotransformation products [1]. Metabolomics profiles acquired through mass spectrometric techniques may reveal the exposure by direct detection of xenobiotics and their metabolites (xenometabolome investigation) and effects by the detection of endogenous metabolites which concentrations may differ from physiological levels following the exposure. The metabolome investigation of mussels have only been done for the co-contamination of As and Sb on alternation of crops. Our study evaluated the potential use of vegetable crops to identify and assess the bioavailability and toxicity of As and Sb in co-contaminated soils using bioassays. Water spinach and
4'-hydroxy-diclofenac, and 10 were phase II metabolites such as amino acids conjugates. Five were reported for the first time in an aquatic organism. Regarding the effects, two main metabolic pathways were found to be impacted by diclofenac exposure. The tyrosine metabolism was mostly down-modulated and the tryptophan metabolism was mostly up-modulated. To our knowledge, such DCF effects on mussels have never been described despite being of concern for these organisms. Atelocollines and serotonin are involved in osmoregulation, and in general release in mollusks [2-4]. Our results highlighted potential impairment of mussel osmoregulation and reproduction following a DCF exposure in agreement with recent publications that have shown reproductive disturbance following DCF exposure in other aquatic organisms such as xenopus [5] or fish [6].


4.2 Metabolomes used to link affected molecular pathways with behaviour outcomes after a single dose of pesticide exposure in mice

P. Leonards, VU University, Institute for Environmental Studies / Department of Environment and Health; H. Vibe, J. Lee, S. Buratovic, P. Eriksson, Uppsala University

Worldwide, serious concern has arisen about the increased incidence of learning and developmental disorders in children. From a scientific point of view, there is no doubt that exposure to neurotoxic chemicals during early brain development can adversely affect learning and development. Various recent epidemiological studies have indicated that exposure to low doses of environmental biologically active contaminants (e.g. pesticides) during human development can have deleterious effects on cognitive development in childhood. The European commission-funded project DENAMIC "Developmental Neurotoxicity Assessment of Mixtures in Child and Animal Models" investigated neurotoxic effects (e.g. learning and developmental disorders) of low-concentration mixtures of pesticides and a number of common environmental pollutants in children. We focus on (subclinical) effects on learning (cognitive skills) and developmental disorders in children (e.g. ADHD, autism spectrum disorders and anxiety disorders). The aims are to develop better and sophisticated tools, procedures and testing methods to screen compounds for (developmental) neurotoxicity, and to improve our understanding of chemical exposures and the observed effects (www.denamic-project.eu). As part of the project, a new alternative assessment strategy based on a combination of in vitro, in vivo assays, omics, and human exposure assessment is under development in order to prioritize compounds, and to further investigate the pathways and mechanism involved in disorders and diseases. The final aim of DENAMIC is to reduce effects of environmental contamination on learning and developmental disorders in children. In the current study metabolomic pathway analysis was used to improve our understanding of the underlying molecular mechanisms of observed effects on behaviour and cognitive function after various pesticide and other contaminant exposures in mice.

4.3 Relationships Between Persistent Pesticide and Metabolomics Profiles in Tissues of Polar Bears From Hudson Bay, Canada

A.D. Morris, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health; R.J. Letcher, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Division; M. Dyck, Government Of Nunavut / Nunavut Department of the Environment; B. Chambrauoli, J. Cosgrove, SGS AXYS

Metabolomics profiles are comprised of targeted endogenous metabolites (< 1 kDa) such as amino acids (AAs), fatty acids (FAs), and membrane lipids such as phospholipidcholines (PCs) to identify changes in the metabolome relates to extrinsic factors, including e.g. exposure to persistent organic pollutants (POPs) and metals. Polar bears (Ursus maritimus) from Hudson Bay (Canada) are differentially exposed to complex mixtures of POPs and metals including total mercury (THg = inorganic + methyl-mercury), and legacy and new POPs. In the present study, quantifiable profiles of 295 organic POPs and THg in fat and liver (representative tissues) were assessed in 14 different regions of the Canadian Arctic, including Hudson Bay (SHB; n = 14) and Western Hudson Bay (WHB; n = 15) male polar bears were collected for multivariate and univariate statistical analyses. Correlated compounds and significantly different or impacted physiological pathways were identified that may be related to differences in POP exposure or other environmental factors. Partial least squares discriminant analysis (PLS-DA) and variable importance in projection (VIP) were applied to the combined metabolite-contaminant profiles of these polar bears, and Spearman correlation analyses were used to establish relationships between metabolites and contaminants, as well as with other biological factors. Forty-one metabolites [membrane lipids, acylcarnitines (ACs), and symmetric dimethyl arginine (SDMA)], and 21 POP discriminated the subpopulations. Perfluorinated alkyl substances (PFASs), polybrominated diphenyl ethers (PBDEs), p,p'-dichlorodiphenyl dichloroethylene (DDE) and some ortho-polychlorinated biphenyls (PCBs) were greater in the SHB bears and changes in the metabolite concentrations had some consistency with previous laboratory studies. Arachidonic acid (ARA), glycerophospholipid and amino acid pathways were identified as being differently enriched or impacted between the subpopulations. Greater ARA in SHB bears may be related to differences in chronic exposure to POPs such as the hepatotoxic PFASs, as ARA is part of the inflammatory response in liver. SDMA and most legacy organochlorine compounds were greater in the WHB bears, which may be indicative of differences in renal function. Consistency of relationships between metabolites, POPs, biomarkers from laboratory studies suggests linkages between POP concentrations and differences in the hepatic metabolome of SHB and WHB polar bears.

4.4 Integrative Omics linkage to reproduction effects of a fungicide in the soil invertebrate Folsomia candida

T.F. Simoes, S.C. Novaís, Polytechnic Institute of Leiria / MARE IPLeiria; T. Natal da Luz, University of Coimbra / Department of Life Sciences, University of Coimbra; J. Sousa, University of Coimbra / Department of Life Sciences; B. Devreese, Ghent University / Laboratory for Protein Biochemistry and Biomolecular Engineering; T. de Boer, Vrije Universiteit; D. Roolofs, Vrije Universiteit / Department of Ecological Science; N. van Stralen, Association of Swiss Environmental Scientists ARES / Department of Ecological Sciences; M. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria

Due to high complexity of ecosystems, environmental risk assessment can be a challenging task and there is the need to develop and validate innovative and reliable tools and integrated approaches for fast detection of changes in population and community structures that can be applied by regulatory agencies. Folsomia candida is among the most sensitive species, and one of the targets that has been selected as a genomic model organism for soil toxicology studies on non-target soil arthropods. This work aimed to determine the toxicity mechanisms of a widely applied fungicide formulation (Bravo500®), with active compound chlorothalonil (CHT), in F. candida, by linking effects at different levels of biological organization like reproduction, gene expression and protein levels, following a time series exposure. Therefore, the aim of this project was to assess the effects of the fungicide formulation on both reproductive endpoints in F. candida and on the gene expression and proteome profiles. The results showed that the fungicide formulation led to a reduction in the number of eggs laid per female, and that this effect was more pronounced in female individuals from a soil sample that had been exposed to the fungicide formulation more than 266 days prior to the study. In addition, the analysis of the proteome profiles revealed that the fungicide formulation led to a modulation of the expression of proteins involved in detoxification and excretion (also involving glutathione), normal cellular respiration and protein metabolism, leading to impairment in development and reproduction. The datasets presented highly significant positive correlations between the gene expression levels at a certain time-point and the correspondent protein products from the consecutive time-point, thus highlighting the importance of considering a time series approach when interpreting the results of the toxicity studies. The datasets thus provide useful insights, exhibiting their relevance in toxicological studies and proving the importance of a time-series analysis in correlations between these datasets.

4.5 Using functional genomics to find mechanisms of herbicide toxicity in Chlamydomonas reinhardtii

A. Zupanic, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; A. Betz, Eawag / UTXO

At present, environmental risk assessment of chemicals is limited to measuring physiological endpoints in model species. To test all chemicals that require testing, a shift to mechanistic-based testing is needed. However neither direct molecular targets nor the stress pathways that lead to adaptation to chemical exposure are usually known. Finding the genes encoding sensitivity or tolerance to chemicals is usually known. Finding the genes encoding sensitivity or tolerance to chemicals is one of the highest priorities of the (eco)toxicological research community. One of the best methods for gene function discovery is functional genomics based on high-throughput sequencing of single-generation mutant lines. These interventions (such as chemical exposure) of interest and mutants which are the most susceptible to the intervention and those that are most tolerant are found. We exposed a pooled library of loss-of-function mutants of Chlamydomonas reinhardtii to three herbicides that target photosynthesis: atrazine and diuron which target photosystem II, and which disrupts the transition of electrons from photosystem I to photosystem II, which leads to production of reactive oxygen species. The pooled library was exposed to the EC20 concentration of each herbicide for 3-4 days, at which time samples from the library were taken for DNA sequencing to find mutants that have become enriched or have disappeared from the culture after exposure (comparing with non-exposed control). The expectation was that the functional genomic profiles of atrazine and diuron would be similar, as the target of both chemicals is the same, while a different profile would be obtained for paraquat. This was indeed the case, with the profiles for both diuron and atrazine enriched for mutant of genes involved in the photosynthesis. The profiles of paraquat also included photosynthetic genes, but also several genes involved in defence against oxidative stress.
stress and lipid metabolism. Finally, there were also several genes that were among the enriched separately for diuron and atrazine, which points to possible different secondary modes of action for both herbicides. While we are currently still analyzing the obtained profiles and individual genes, our results demonstrate that functional genomics is a useful method for discovery of molecular mechanisms of chemical toxicity.

**416** Harmful effects of plastic litter and mitigation strategies in the Mediterranean Sea

Concern about the occurrence, quantity and effects of marine litter in the world's ocean and seas has grown rapidly in recent years, attracting interest from a wide range of stakeholders, environmental NGOs, the scientific community, the media and the general public. Mediterranean Sea, which is a crucial biodiversity hotspot and a critically polluted area, has been also been described as one of the areas most affected by marine litter, including microplastics, in the world. Recent studies in different regions of the basin suggested that some areas are affected by important concentrations of microplastics and plastic additives, representing a potential risk for endangered species (baleen whales, sea turtles, filter feeders sharks) and for the all Mediterranean biodiversity. To cover the current knowledge gaps on this issue a harmonised methodological approach for the assessment of the marine debris impact on Mediterranean biodiversity is needed. The quantification of marine debris/microplastics in the marine environment can depend on several environmental factors and change according to multiple oceanographic features, and therefore, cannot reflect the potential impact on organisms and ecosystems. The information obtained by biodicator species could better integrate the spatial and temporal presence of marine litter/microplastics in the marine environment. In addition, the use of biondicators can allow to measure not only the occurrence of marine litter in the species and its environment but also the threat posed to organisms by the evaluation of contaminants accumulation and any potential biological effect. A new integrated monitoring tool that would provide the information necessary to design and implement future mitigation actions in the Mediterranean basin is proposed. Applying ecological and biological criteria to the most threatened species obtained by statistical analysis, biodicator species for different habitats and monitoring scale were selected. To assess the harm by marine debris ingestion a threefold approach, simultaneously measuring the presence and effects (accumulation of plastic associated contaminants and biomarker responses), can provide the harm and the sub-lethtl effects to organisms related marine litter ingestion. The gaps pointed out by this research and the biodicators species selected could represent a step forward for the risk assessment and the implementation of future mitigation measure for the Mediterranean area, habitat and species affected by marine litter ingestion.

**417** Impact of marine litter in the Mediterranean Sea: monitoring and specific reduction measures within MSFD

F. Giliani, IFREMER

Preliminary assessments of the state of the marine environment, monitoring and the formulation of environmental targets are perceived as part of the continuous management process within the MSFD. Of the 11 descriptors listed in Annex I of the MSFD for determining GES, Descriptor 10 has been defined as “Properties and species affected by marine litter ingestion. The gaps pointed out by this research and the biodicators species selected could represent a step forward for the risk assessment and the implementation of future mitigation measure for the Mediterranean area, habitat and species affected by marine litter ingestion.

**418** Addressing the growing threat of marine litter: NGOs essential role in strengthening the science-policy-society interface

T. Vlachogianni, Mediterranean Information Office for Environment, Culture and Sustainable Development (MIO-ECSDE)

The growing urgency and complexity of interconnected societal challenges, such as marine litter, demand that they be addressed through the strengthening of the science-policy-society interface so as to provide the necessary conditions for translating research-based knowledge into effective action. NGOs are essential partners in promoting environmental conservation and sustainable development. Their active participation at local, national and transboundary level in all phases of projects and processes, from their design, implementation in the field, operationalization, monitoring and evaluation, contributes not only to increased transparency, wide visibility and outreach of the project or process, but also to enhanced overall quality and increased ownership of the outcomes, as well as improved possibilities for replication of its activities. In full acknowledgement of the prominent role of NGOs in the realm of environmental governance, MIO-ECSDE, a Federation of some 130 Mediterranean NGOs working on Environment and Sustainable Development, in fulfilling its vision and mission, has developed and implemented a number of actions on the science-policy-society interface that address the growing threat of marine litter in the Mediterranean, ranging from the monitoring and influencing of relevant policy, all the way to hands on and pilot activities (e.g. within the framework of the IPA-Adriatic DeFishGear, the FP7 MARLISCO, the Interreg Med ACT4LITTER, the EU SWIM-H2020 SM, etc.). How marine litter and its inherent environmental, economic, social, political and cultural dimensions have been tackled by MIO-ECSDE illustrates the breadth of scale of involvement and interventions required for the protection of the marine and coastal area. The term “biodegradable” could be misunderstood and induce the public in its belief that the NGO community brings to environmental governance, such as leadership, creativity, flexibility, entrepreneurship and capacity for vision and long-term thinking. As scientists call for more research on global environmental changes in an effort to gain a better understanding of the human induced implications for all of life on Earth, it remains an inconvenient truth that if the world had acted upon the knowledge that the scientific community already produced, the state of many ecosystems would be different today. The NGO community has an essential role to play in terms of strengthening the science-policy-society interface towards an effective response from society on the issue of marine litter and other societal challenges.

**419** Biodegradable plastics: potential application in aquaculture and other applications with high risk of dispersion

P. Dejli Innocenti, Novamont SpA

The problem of plastic marine debris is caused by inadequate waste management and increase of investments in prevention and recovery programs. The bioplastics industry does not consider biodegradability as a license for littering in the environment. All packaging and consumer products must be recovered in some way at their end of use and, in certain contexts, biodegradability allows recovery through organic recycling. This option is contemplated by the European Directive on Packaging and it is beneficial whenever packaging is mixed with food waste (biowaste). The term “biodegradable” could be misunderstood and induce the consumer to littering. In order to avoid such problem, the biodegradable packaging is labelled “compostable” or “biodegradable and compostable”. The term “biodegradable” is only used in business-to-business communications (e.g. “biodegradable” mulch films are used by professionals who are well aware of the meaning of the term). In agriculture, tests specific to soil define mulch film biodegradation because soil conditions are different from composting. Similarly, tests specific to the marine environment are now under development at ASTM and ISO level. Some biodegradable plastics showed biodegradation levels (as CO2 evolution) comparable to cellulose in less than 1 year using these test methods. Generally speaking, the environmental risk depends on the concentration of the environmental stressor and on its residence time in the environment. The lower the concentration and the shorter the residence time, the better. Bioplastics do not immediately disappear upon exposure to the sea. However, biodegradability reduces the risk by reducing the stressor’s residence time. Concluding, the idea of solving the problem of plastics in the ocean just by shifting to bioplastics is groundless (bioplastics does not disappear “by magic”). However, for those applications at high risk of dispersion, biodegradable plastics can be suitable for plastic products known to wear down or become stranded (e.g. fishing gear) and scatter into the sea. Bioplastics hold promise for aquaculture professional applications (e.g. nets for mussels farming) where the disposal of plastic waste is an inevitable outcome. Bioplastics can be the right solution for specific products, if properly applied.
Management (RPML) in December 2013, providing for a set of programmes of measures and implementation timetables to prevent and reduce the adverse effects of marine litter on the marine and coastal environment. It includes innovative and traditional measures of a policy, regulatory and technical nature, addressing different aspects of marine litter prevention and management from land and sea based sources. The Regional Plan measures impose clear obligations regarding the waste management hierarchy, closure of illegal dumping/dumpsites, shift to sustainable consumption and production patterns, removal of existing marine litter using environmental sound practices e.g. fishing for litter, clean up campaigns, port reception facilities at possibly no special fees, and monitoring, assessment and reporting on implementation of measures as well as enforcement of national legislation. Significant effort has been made on marine litter at regional and national levels, since the adoption of the RPML. The Mediterranean countries have included marine litter in their updated National Action Plans (NAPs) and the ambitious and novel Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea and Coast and Related Assessment Criteria has been adopted since 2016 by the Mediterranean countries including two common and one candidate indicators on marine litter. Furthermore, with the support of the EU-funded Marine Litter MED project, UN Environment/IMAP is implementing key reduction and prevention measures on marine litter in the Southern Mediterranean. At the invitation of the UN Environment/MAP, the Regional Cooperation Platform on Marine Litter in the Mediterranean was established in September 2016, consisting of more than 20 international and regional partners with a clear mandate on marine litter management. The aim of the platform is to assist in the cooperation within the RPML, a further step has been results, towards a more effective marine litter management at regional level. One of the latest developments of the UN Environment/MAP is the 2017 Mediterranean Quality Status Report (QSR) that dedicates two chapters on marine litter related to beach, floating, and seafloor marine litter.

421 Science and awareness: a Mediterranean Connection Against Marine Litter - First Results of the Commitment Presented at UN Ocean Conference G. Zampetti, Legambiente

“Science and awareness: a Mediterranean connection against marine litter” is the title of the voluntary commitment that Legambiente and the University of Siena presented at the last UN Ocean Conference in New York, in June 2017. There was a connection between scientific research and raising awareness built to tackle marine litter in the Mediterranean Sea by sharing experiences and developing new integrated action. In 2013, Legambiente started the monitoring of floating macro litter within Goletta Verde, one of the most popular campaigns of analysis and information about sea pollution. In the last few years, there has been an increase in the marine-litter-related activities, including surveys using citizen science and awareness raising projects. Following the Scientific Environmentalism purpose Legambiente applied official methods and protocols to contribute to the estimation of the marine litter amount in seas and along the coastline, cooperating also with national research institutes, universities and other research organizations. Now, thanks to the cooperation with the University of Siena, a further step has been results, carrying out studies and research on the presence of contaminants adsorbed by floating plastics and their potential effects on biodiversity. The first results of this research will be presented in this meeting.

422 Discussion

423 Final Remarks

G. Leone, UNEP/Mediterranean Action Plan

Ecological risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (II)

424 Biodiversity patterns in the GLOBAQUA basins and their relationships with multiple stressors

N. De Castro-Catalá, Universitat de Barcelona / Department of Evolutionary Biology, Ecology and Environmental Sciences; I. Muñoz, University of Barcelona / Department of Environmental Sciences; E. Kalogianni, I. Karaozou, A. Vourka, E. Stouli, L. Vardakas, Hellenic Centre for Marine Research, Institute of Marine Biological Resources & Inland Waters (HCMR); M. Paunovic, University of Belgrade, Institute for Biological Research Sinisa Stankovic; C. Borrego, M. Petrovic, Catalan Institute for Water Research ICRA; S. Sabater, ICRA Catalan Institute for Water Research; S. Diaz-Cruz, M. Farre, IDAEA-CSIC / Environmental Chemistry; S. Monllor, National Institute of Environmental Assessment and Water Research IDAEA-CSIC / Department of Environmental Chemistry; M. Lopez de Alda, Institute of Environmental Assessment and Water Research; S. Lutz, Hennholz Centre for Environmental Research

Rivers suffer from an important decrease in species diversity compared to other aquatic and terrestrial ecosystems due to a variety of stressors related to human activities. Species play different roles in the functioning of the ecosystem, and their species richness may reduce the response capacity of the ecosystems to a stressor. The effects on diversity will obviously differ based on the type of stressors and their combination and severity, as well as on the characteristics of the local community composition, and the community tolerance to the type of stressor affecting the system. This study presents the results of the analyses of the biodiversity patterns for different taxonomic groups (e.g., algae, macrophytes, macroinvertebrate and fish communities) related to environmental pressures. The data obtained from the field work conducted in three of the Glaobauca case study basins (Adige, Sava and Evrotas) has been evaluated according to structural biological community parameters (species composition and abundance). The most evident relationships between changes in species richness and diversity were explained by changes in hydrology (e.g. mean discharge, intermittency) and morphological changes in the basins (e.g. land uses, channel transformation). The presence of pharmaceutical products (urban pollution) and pesticides was related to lower insect richness. Also emerging compounds, despite their low concentrations, were related with a reduction in macrophyte diversity. These results open the way to compare responses in the studied basins as representative of the European reality of the combined effects of multiple stressors on biological diversity.

425 Changes in pCO2 after the reproductive toxicity of common active pharmaceutical ingredients

C.M. Hild, N. Wichmann, C. Lewis, K. Smith, A. Wilson McNeal, University of Exeter / Department of Biosciences; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; T.S. Galloway, University of Exeter / Biosciences

Increasing pCO2 in aquatic environments is occurring as a consequence of the release of anthropogenic carbon dioxide in to the atmosphere, which is absorbed by surface waters. Traditionally this stressor has been studied in isolation, however environmental variation such as changes in pCO2 or pH can alter the ionisation and consequently the effects of contaminant compounds. A notable group of compounds susceptible to these changes include the active pharmaceutical ingredients (APIs), which often have pH-specific biological effects and are increasingly detected in sewage effluent and receiving waters. The aim of this study is to investigate the hypothesis that changes in pCO2 alter the effects of active pharmaceutical ingredients on sperm swimming parameters and fertilisation success. The species chosen to explore these effects were the lugworm Arenicola marina and the purple sea urchin Paracentrotus lividus due to them being keystones coastal species in areas where API contamination is occurring, and them being established model species for artificial spawning in controlled laboratory conditions. We used a range of neonicotinoid pesticides and non-steroidal anti-inflammatory drugs (NSAIDs) at both environmentally relevant and mechanistic concentrations to test this relationship due to them having chemical properties identified as making them pCO2-sensitive. pCO2 conditions equating to current (8.10 ± 0.1) and future (7.75 ± 0.1) pH conditions were selected for this study. Endpoints measured included a range of sperm motility parameters, using computer-assisted sperm analysis (CASA) software and fertilisation success. Our findings indicate that pCO2 conditions may play a vital role in the reproductive toxicity of common chemical pollutants through changes in sperm swimming parameters and consequently fertilisation success. Our results also indicate that this combination of stressors is compound-specific between contaminants with multidirectional effects dependent on conditions of the exposure. Our findings provide novel evidence that future environmental conditions may substantially alter the role which contaminants such as APIs play in the environment. PI contamination is likely to increase following anthropogenic pressures such as population growth and healthcare advances. As a result, we believe it necessary to consider future conditions such as increased pCO2 conditions when accurately assessing the environmental risks of such compounds.

426 From individual traits to ecosystem functioning: natural phytoplankton biodiversity and climate related activities. Species play different roles in the functioning of the ecosystem, and their species richness may reduce the response capacity of the systems to a stressor. The effects on diversity will obviously differ based on the type of stressors and their combination and severity, as well as on the characteristics of the local community composition, and the community tolerance to the type of stressor affecting the system. This study presents the results of the analyses of the biodiversity patterns for different taxonomic groups (e.g., algae, macrophytes, macroinvertebrate and fish communities) related to environmental pressures. The data obtained from the field work conducted in three of the Glaobauca case study basins (Adige, Sava and Evrotas) has been evaluated according to structural biological community parameters (species composition and abundance). The most evident relationships between changes in species richness and diversity were explained by changes in hydrology (e.g. mean discharge, intermittency) and morphological changes in the basins (e.g. land uses, channel transformation). The presence of pharmaceutical products (urban pollution) and pesticides was related to lower insect richness. Also emerging compounds, despite their low concentrations, were related with a reduction in macrophyte diversity. These results open the way to compare responses in the studied basins as representative of the European reality of the combined effects of multiple stressors on biological diversity.

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acclimated to. Many species of algae are highly adaptive and can respond by growing rapidly after disturbance. However, the diffuse burden of chemical pollutants concomitantly present in freshwater ecosystems, can favour species of algae that are more tolerant to chemical pollution to the detriment of more adaptive ones. We carried out a field experiment, using a non-invasive mesocosm approach, to study the response of phytoplankton communities to combined physical and chemical anthropogenic stressors. We aimed at investigating if chemical pollution can prevent the ecosystem to promptly re-gain structures and functions after extreme events. An extreme meteological event was mimicked by sampling and mixing phytoplankton communities over the entire water depth of the lake. The chemical stressors comprised of a mixture of chemical pollutants added to the mesocosms at five increasing concentrations (typically considerably below the EC50 of individual substances). The mixture included 12 pharmaceuticals and personal care products commonly detected in lakes and rivers in Europe. In addition, a mixture isolated from treated waste water effluents was used as a treatment of its own. Individual level traits (cell size, pigments), community parameters (biomass, functional diversity, species composition and photosynthetic efficiency), chemical concentrations and nutrients were routinely monitored during the 3 weeks experiment. Overall, the stressor contamination and dramatically changing ocean. The results here gathered further strengthen the need to carry out greater research efforts to understand how multiple environmental stressors interact with each other.

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The role of multiple stressors in an Alpine river and the response of the macroinvertebrate community

M. Giulivo, Universita Cattolica del Sacro Cuore / Institute of Agricultural and Environmental Chemistry; E. Gabbert, Wageningen University / Social Sciences; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environmental Studies; S. Hahn, Fraunhofer ITEM / Chemical Risk Assessment; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; M. Nendza, Analytisches Laboratorium A key objective of the European chemicals legislation REACH is to ensure that the risks caused by substances of very high concern (SVHC) are adequately controlled. The two regulatory procedures adopted in REACH to control the risks arising from SVHCs are authorisation and restriction. Both regulatory instruments make use of socio-economic analysis (SEA), which is generally defined to be a tool for assessing all relevant positive and negative impacts from substances' use or non-use, and for comparing these impacts across different scenarios. Impacts arising from chemicals' use, including PBT/vPvBs, are use-specific. Furthermore, due to stock pollution properties of BPT/vPvBs, impacts may last for long periods and even long after emissions have ceased. In addition, information about (long-term) impacts needs to be balanced with costs of emission reduction and abatement. Acknowledging that monetary valuation of impacts using stated or revealed preference methods is not possible for a broader set of PBT/vPvB substances, the evaluation of PBT/vPvB substances in a SEA has to rely on cost-effectiveness analysis (CEA). This requires specifying benchmark values, i.e.

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Coping with antidepressants in a changing ocean: tissue bioaccumulation and behavioural implications in juvenile Argyrodes regius exposed to venlafaxine

A. Maulvault, Instituto Português do Mar e da Atmosfera / Division of Aquaculture and Seafood Upgrading; L. Marques, Instituto Português do Mar e da Atmosfera / Division of Aquaculture and Upgrading; V. F. Barbosa, Portuguese Institute of the Sea and Atmosphere IPMA / Division of Aquaculture and Seafish Upgrading; R. Alves, IPMA, I.P.; J. P. A. Pinto, Fundação para a Ciência e a Tecnologia / Centre for Environmental Research ICAR; J. Rocha, MARE / Marine and Environmental Sciences Centre; M. Diniz, UCIBIO, UCIMAR, UCIMAR, UCIMAR, UCIMAR, UCIMAR; L. Marques, Portuguese Institute of the Sea and Atmosphere IPMA / Division of Aquaculture and Upgrading

Anthropic activities have contributed to great environmental challenges, remarkable chemical contamination and dramatic climate change. Both factors strongly affect marine ecosystems and are expected to worsen in the future, threatening marine species’ welfare and survival. Yet, information on how fish will cope with the presence of chemical contaminants in the future is still extremely limited. Emerging and non-regulated pharmaceutical and personal care products (PPCPs) have recently become a great environmental concern, since these compounds are often discharged into the aquatic environments, but their elimination through conventional wastewater treatments is rather limited. Within pharmaceuticals of human use, venlafaxine (VFX) is one of the most ubiquitous in the aquatic environment, often reaching higher concentrations than other well-known psycho-active drugs, such as fluoxetine (i.e. Prozac). In this context, the present study was aimed at assessing for the first time the effect of seawater warming and acidification on VFX bioaccumulation in fish tissues, as well as the behavioural implications resulting from the exposure to these stressors (alone or combined), using juvenile meagre (Argyrosomus regius) as model organism. Overall, data evidenced that seawater temperature and pH levels can strongly affect the bioaccumulation patterns of antidepressants in marine organisms. Furthermore, the distinct behavioural patterns observed when VFX contamination, acidification and warming acted alone or in combination evidenced that multiple environmental stressors should be considered when assessing fish behaviour under a future changing ocean. The results here gathered further strengthen the need to carry out greater research efforts to understand how multiple environmental stressors interact with each other.

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A modelling approach to assess present and future land use pressures on a salmonid river: a case study in the River Tamar catchment (UK)

M. Assuncao, CelaS Lowestoft Laboratory; P. E. Posen, Centre for Environment Fisheries and Aquaculture Science Cefas; M. G. Hutchins, Centre for Ecology Hydrology A linked-model approach was applied to the River Tamar catchment (Southwest, UK) to assess current and likely future impacts of land use practices on salmonid populations; Atlantic salmon (Salmo salar) and brown trout (Salmo trutta). Land use data were incorporated into a validated water quality model (QUESTOR) at the sub-catchment and sub-basin scale and a baseline generated for the period of 2000 to 2012. Future scenarios of water quality were also generated based on land use practices recommended under ongoing catchment initiatives. Overall, the baseline water quality parameters found to be non-compliant with “Good Status” under the Water Framework Directive, or outside the freshwater requirements for salmonids, coincided with reported land use pressures in the Tamar, namely, catchment-wide frequent elevated levels of inorganic phosphorus and, less frequently, suspended sediments. Tested future land use scenarios bringing improvements in inorganic phosphorus levels included upgrading technology at sewage treatment plants and the implementation of riparian buffer strips, combined with a corresponding reduction in livestock density. These improvements however, were marginal therefore the tested land use scenarios should be adjusted and/or new scenarios explored. Baseline seasonal average values for water quality parameters in different areas of the catchment explained 68% of salmon and trout fry density variation, and showed how different parameters might be affecting the density of these two species. Our results suggest that catchment pressures are contributing to the regulation of salmonid fry densities in some tributaries and upper catchment reaches. Moreover, they can be used to inform local and seasonal targeted measures, aimed at improving those water parameters most influential on fry densities. These types of measures are likely to bring the highest benefits to salmonid productivity in the catchment.

PBt/PvB & PMT/PvM substances and Non-extractable (NER): Scientific strategies, Analytical challenges and Regulatory Issues (II)

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Evaluation of PBt and PbV substances based on exposure dynamics, use-specific impacts and costs for emission reduction or abatement in the context of REACH

S. Herbert, Wageningen University / Social Sciences; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environmental Studies; S. Hahn, Fraunhofer ITEM / Chemical Risk Assessment; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; M. Nendza, Analytisches Laboratorium A key objective of the European chemicals legislation REACH is to ensure that the risks caused by substances of very high concern (SVHC) are adequately controlled. The two regulatory procedures adopted in REACH to control the risks arising from SVHCs are authorisation and restriction. Both regulatory instruments make use of socio-economic analysis (SEA), which is generally defined to be a tool for assessing all relevant positive and negative impacts from substances' use or non-use, and for comparing these impacts across different scenarios. Impacts arising from chemicals' use, including PBt/PvB, are use-specific. Furthermore, due to stock pollution properties of PBt/PvB, impacts may last for long periods and even long after emissions have ceased. In addition, information about (long-term) impacts needs to be balanced with costs of emission reduction and abatement. Acknowledging that monetary valuation of impacts using stated or revealed preference methods is not possible for a broader set of PBt/PvB substances, the evaluation of PBt/PvB substances in a SEA has to rely on cost-effectiveness analysis (CEA). This requires specifying benchmark values, i.e.
431 Grouping and relative ranking of the impact potential of PBT/vPvB substances for comparative assessments in the context of socio-economic analysis under REACH

M. Nendza, Analytisches Laboratorium; S. Hahn, Fraunhofer ITEM / Chemical Risk Assessment; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environmental Stress Indicators of the groups and subgroups of chemicals with known impacts, serving as points of reference for the impact evaluation. The relative ranking of PBT/vPvB substances is based on an impact score, which captures diverse properties and effects of target substances. The impact score consists of individual scores assigned to expected environmental stocks, possible effects of PBT/vPvB substances on the environment and on human health via the environment (toxicological benchmarks), and to other specific concerns. The resulting fingerprints of concern (pattern of the individual scores) and the overall scores for impact potential can be used for comparative assessments. For example, if similar fingerprints are observed for two substances with a similar use, the total score gives an indication which substance might be less (or more) critical. For 17 case study chemicals, data on partitioning properties (log Kow, log Koa), stocks in water/sediment and soil, long range transport potential (LRTP), overall persistence (Pov), toxicological benchmark values for water and soil, CRM properties (H-phrases), endocrine disruption (ED) potential, production/emission volume, and use pattern have been collected from REACH dossiers or estimated with suitable tools. The examples illustrate the possibilities and limitations of the grouping and relative ranking to describe and evaluate differences of PBT/vPvB substances with regard to impact potential. Based on current knowledge, this grouping and relative ranking can guide the formation of concern-based categories for a possible read-across or comparative evaluation of impact potential of PBT/vPvB substances. Acknowledgement – This work was funded by the European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs under contract number 30-CE-083097200-26 'Approach for evaluation of PBTs subject to authorisation and restriction procedures in context of socio-economic analysis'.

432 Interpretation of non-extractable residues (NERs) in the persistence assessment

U. Johnke, Federal Environment Agency (UBA) / IV 2.3 Chemicals; V. Bonnomet, European Chemicals Agency; I. Doyle, Environment Agency / Evidence Directorate; R. Hornek-Gaukster, Environment Agency Austria; A. Kapanen, European Chemicals Agency - ECHA; M. Kästner, Helmholtz centre for Environmental Research – UFZ; M. Razum, Roche; J.R. Peltola-Thiés, ECHA-European Chemicals Agency; L. Ribeiro; A. Schäffer, Institute for Environmental Research RWTH Aachen University; M. Telscher, Bayer AG Division CropScience/Environmental Fate / Development Environmental Safety; F. Schmidt, C. Leake, Bayer AG Non extractable residues (NER) so called “bound residues” of plant protection products are formed in soil as a result of degradation processes. Due to their inherent nature, analysis and further assessments of bound residues are challenging. In a recent publication (Posberg et al. 2016) a distinct analysis of NER has been reported. The method relies on the determination of natural amino acids as the main component of bound residues in soil. The amino acids were liberated via a digestion of the soil with 6 N HCl at 110°C. Within this presentation we focus on the utility and validity of this analytical method using 14C bromoxynil and an agricultural soil from Germany. As a main result above 55% of bound residues could not be liberated and remained bound to the soil even after such a harsh digestion step. During further clean-up of amino acids further losses of radioactivity of approximately 40% of those liberated bound residues has been observed. Further analyses elucidated up to 50% of those unidentified losses, however, in total approximately 75% of bound residues stuck to the soil and therefore could not be identified or unambiguously assigned. However, 16% of the generated NER was extractable and could be assigned to amino acids. Both results indicate that bound residues will not contribute to future risks or hazards because they are on one hand not bioavailable or on the other hand they have been converted to natural biogenic residues like natural amino acids.

434 Elucidation of the nature of soil bound non extractable residues

M. Telscher, Bayer AG Division CropScience/Environmental Fate / Development Environmental Safety; F. Schmidt, C. Leake, Bayer AG Non extractable residues (NER) so called “bound residues” of plant protection products are formed in soil as a result of degradation processes.
Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Ecological chemistry; K. Hund-Rinke, Fraunhofer IME / Department of Ecotoxicology; J. Lahr, Wageningen Environmental Research; J. Deneer, Wageningen Environmental Research / ERA team

There is already a long discussion around the bioavailability and ecotoxicological relevance of Non Extractable Residues (NER) in soil. Is NER formation a definitive indication of hazardousness and should it be considered to be a hidden hazard? NER can only be established using labelled chemicals (e.g. 14C) and cannot be measured with conventional chemical analytics. But even using labelled compounds uncertainty exists about the identity of measured radioactivity. Do we measure: 1) Strong adsorption or association of the parent chemical or breakdown product with mineral and/or organic matter, 2) Mineralisation and incorporation of carbon into microbial biomass and carbonates. These questions ask for understandable and measurable parameters. The approach of Ortega-Calvo et al. (2015) has been followed, because this approach defines clear and measurable fractions. The only not measurable fraction is NER, but can be considered as a residual fraction if all others are measured. Considered are: Chemical present in the water phase, actual available, (Passive sampling or CaCl₂-extraction) A potentially available fraction in equilibrium with a water phase (tracer for unknown NER) and a total extractable amount, measured with a (standard) method NER is considered, but mentioned as non-measurable and also non-bioavailable. We studied three NER-forming chemicals and followed their fate in a period of 6 months after addition. An important part of the study were experiments using 14C chemicals. In first experiments formation of Non-Extractable 14C was observed for all chemicals. For the chemical Tri-NitroToluene (TNT), NER-formation was reproducible and NER formation during aging removed toxicity. By removing the bioavailable fractions directly after spiking and after aging it was also possible to remove toxicity. The experiments with and also without labelled TNT clearly showed that toxicity was caused by the bioavailable chemical and not by NER. The test developed can be used if the fate of the chemical including NER formation is obvious With the other selected chemicals Cypermethrin and Carbendazim, results were less clear, because there was a large uncertainty in NER-formation. The degree of biodegradation was not reproducible for Cypermethrin and unexpected losses occurred with Carbendazim. This gave a very large uncertainty about NER using non-labelled compounds. For these compounds it is not possible to draw conclusions from only a non-labelled experiments.

LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (I)

436 How to make LCA fit for purpose as decision making tool E. Mieraes, PRe Sustainability; A. Gaasbeek, PRe Consultants / Consultancy; J. Coustillas, PRe Consultants

To understand how Life Cycle Thinking (LCT) and Life Cycle Assessment (LCA) can be improved to support decision making we first have to look at how decisions are made. One of the first distinctions that are made when it comes to decision making is between normative and descriptive decision making. The latter describes how people actually make decisions and that can be quite irrational, as also Daniel Kahnemann, the Nobel Prize Winner, argues in his book “Thinking Fast and Slow”. The first tries to define how to come to the best option, assuming that decision makers are fully rational and that the world can be modeled accurately. These are quite opposite ways of how decisions are made. The second distinction to be made is between what type of decisions are made, by whom and what the objectives are. It’s a big difference if you want to make a decision about different options for new products, determine the long term company strategy or select the most sustainable supplier. Even more so, the objectives will differ per organisation or even situation and thus the criteria will also be different. In other words: the context of the decision determines what support is needed and what’s the relevance of the outcomes. Results can have a different meaning in different context. Therefore, it’s important to assess first which methods are fit for purpose to support decisions in a specific context. To enable this, we want to introduce an intermediate step to determine whether LCA, LCT or any other assessment is best suited to answer the questions that are relevant in a specific decision making situation. For this goal we developed tools to the water phase (tracer for unknown NER) and a total extractable amount, measured with a (standard) method NER is considered, but mentioned as non-measurable and also non-bioavailable. We studied three NER-forming chemicals and followed their fate in a period of 6 months after addition. An important part of the study were experiments using 14C chemicals. In first experiments formation of Non-Extractable 14C was observed for all chemicals. For the chemical Tri-NitroToluene (TNT), NER-formation was reproducible and NER formation during aging removed toxicity. By removing the bioavailable fractions directly after spiking and after aging it was also possible to remove toxicity. The experiments with and also without labelled TNT clearly showed that toxicity was caused by the bioavailable chemical and not by NER. The test developed can be used if the fate of the chemical including NER formation is obvious With the other selected chemicals Cypermethrin and Carbendazim, results were less clear, because there was a large uncertainty in NER-formation. The degree of biodegradation was not reproducible for Cypermethrin and unexpected losses occurred with Carbendazim. This gave a very large uncertainty about NER using non-labelled compounds. For these compounds it is not possible to draw conclusions from only a non-labelled experiments.

437 Using Life Cycle Assessment (LCA) to Evaluate Global 6-Aminopenicillanic Acid (6-APA) Manufacture and Make Recommendations for Future Developments in the Biopharmaceutical

C. Chiu, University College London / Department of Biochemical Engineering; N. Titchener-Hooker, University College London / Department of Biochemical Engineering; P. Lettieri, University College London / Chemical Engineering

6-Aminopenicillanic acid (6-APA) is the beta-lactam nucleus of penicillin and is the intermediate to most semisynthetic antibiotics. Manufacturing of the nucleus represents one of the largest production scale processes within the biopharmaceutical industry. The environmental impacts associated with the industry are poorly understood, due to limited life cycle assessment (LCA) studies in the literature, the paper presents a LCA of 6-APA production to illustrate the burdens manufacture places on the environment as a function of manufacturing location. We make recommendations for future development of large scale biopharmaceutical manufacture by drawing on our 6-APA analysis where necessary. New process data for manufacture producing 2000 Tones of 6-APA per annum has been modelled under USA operating conditions and a LCA hot-spot analysis was carried out. A process at this scale has a global warming potential (GWP) of 143,000 tonsCO₂eq/yr. which is largely caused by the high annual fossil fuel usage. The energy mix selected for the model is critical. Choosing a USA mix comprising mostly non-renewable resources provided the base case. Switching to a renewable energy mix to a Brazil mix (constituting a higher proportion of renewable resources), the contribution to climate change was reduced by 15%. Manufacture in China and India where coal combustion is the main source for electricity; the emissions were significantly higher (20%). Other location dependent variables were inputted into the model in conjunction with the switch of energy mix. Depending on the location’s water scarcity, the burden of 6-APA on this parameter varies greatly, A very high degree of water efficiency was seen when switching production from US to China. This is due to the higher use of hydroelectric power in the national energy mix and lower abundance of water in China. Production itself is water intensive due to high volume required for fermentation media and cleaning. Thus, overseer of local freshwater may compete with other sectors, e.g. agriculture, accessing this resource. This suggests that location production is a critical factor in the planning of biopharmaceutical manufacturing.

438 A SUSTAINABILITY PERFORMANCE-BASED METHODOLOGY AND TOOL FOR ECODESIGN: the case of transport infrastructures D. Le Peng, The University of Nottingham / Nottingham Transport Research Engineering Centre NTNEC; J. Oliveira Dos Santos, IFSSTTAR; S. Bressi, University of Palermo; S. Brodie, The University of Nottingham; J. Bryce, AMEC Foster Wheeler; V. Cerezo, IFSSTTAR; T. Parry, The University of Nottingham; G. Di Mino, The University of Palermo

The importance of sustainability in transportation infrastructure has raised in recent years due to the link between anthropogenic activity and global climate change, as well as in consequence of the ongoing development of models quantifying the social and economic impacts resulting from infrastructure development. Therefore, addressing the sustainability of transportation infrastructures requires exploring the environmental, social, and economic impacts of technological options while balancing the often-conflicting priorities of different stakeholders. In this paper, we introduce a decision support tool (DST) developed in the scope of the training-through-research programme Sustainable Pavements & Railways Initial Training Network (www.superitn.eu). It consists of a computational platform that implements a conceptual framework developed to quantify sustainability. It comes with a set of sustainability indicators tailored to both road and railway systems as well as several objective and subjective weighting methods. Amongst those belonging to the last category, the DST includes a set of default weights derived from an Analytical Hierarchy Process (AHP)-based survey that engaged stakeholders from different sectors and from several European countries. At last, the Preference Ranking Organization Methodology of Enrichment Evaluation II (PROMETHEE-II) MCDM method is employed for prioritizing the most sustainable pavements and railway transport solutions at the design stage. The DST will be freely available and can be used at professional level, by professionals interested in advancing sustainability in transportation, as well as for educational purposes, to provide knowledge and educate on the use sustainability concepts and on what are the important issues to consider during the sustainable transportation decision-making process.
to be used, including LCA, but not necessarily limited to it. Moreover, in every LCA, it is in a first step important to specify goal and scope for the further analysis, and it is worthwhile to be aware of aspects which have an influence on the overall environmental impacts of an investigated product. So far, goal and scope in LCA is conducted typically without a diagram or visualization of relations between different aspects to be decided about in goal and scope. We introduce influence diagrams and advanced hot spot analysis methods to both “tailor” the approaches to be applied for each different sustainability of a given situation and to shape goal and scope of an LCA, where LCA is part of said portfolio. As an application, we develop and present a causal loop diagram for sustainability assessment of mining in general, and apply this to specific mine sites in Finland, Portugal, and South Africa, where this approach is currently applied, led by GreenDelta, in the European Horizon 2020 research project ITERAMS. In the presentation, the developed causal loop diagram and the approach for obtaining the diagram for the case will be explained, with results from the ITERAMS project. Results are quite promising and we believe that using causal loop diagrams in sustainability and life cycle assessments helps to clarify selection of the (combination of) appropriate tools for the assessment, and help to structure the goal and scope setting in LCA.

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Life Cycle Sustainability Assessment for Improved Space Mission Design
A.R. Wilson, M. Vasile, University of Strathclyde / Department of Mechanical & Aerospace Engineering; K. Baker, Glasgow Caledonian University / School of Engineering & Built Environment
The adoption of the Paris Agreement and Sustainable Development Goals in 2015 has been the driver for a more coordinated global approach towards achieving environmental sustainability. However, to be successful, this vision must run through every sector of society and the space industry is no exception. In the context of renewed global awareness on environmental sustainability, Life Cycle Assessment (LCA) is an important environmental management technique increasingly applied within the space industry to assess the environmental impacts of products over their entire life cycle. The European Space Agency (ESA) began work on this topic in 2009, employing an internal concurrent design study called ECOSAT to consider the life cycle impact of the design, manufacturing, launch and operations of a satellite. Since then ESA has continued to develop LCA methodology for the space sector, creating the first set of LCA guidelines for space systems in 2016 and now it is preparing to integrate LCA into the concurrent design process. Whilst space-based LCA is still in its early stages, its further development relies on it being increasingly employed within the broader space sector to give parity across the industries. For this reason, moving towards space-based Life Cycle Sustainability Assessment (LCSA) is a logical next step which allows for the third pillar of sustainability (environment, society, economy) to be addressed within one assessment. Tailoring this integration for space systems will allow the industry to become more accountable and responsible for their operations by taking into account the full spectrum of life cycle sustainability issues associated with the operation of space systems. This paper will present the LCSA methodology used in an open-source platform under development at the University of Strathclyde, outlining the global and local space and economic aspects with environmental LCA to evaluate the life cycle impacts of space systems. As adverse impacts are more difficult to modify the later into the design process that they are identified, the integration of LCSAs into the concurrent design process is essential for the early mitigation of sustainability issues. As such, the intention of this platform is to help decision-makers choose sustainable technologies and products at the design stage by determining those that are not only cost-efficient, eco-efficient or socially responsible, but also ones that can easily justify and evidence their sustainability.

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How can Agent-based Modeling improve decision making in Life Cycle Assessment?
A. Millot, University of Bordeaux / The Life Cycle Group CyVi; P. Loubet, University of Bordeaux / ISM CyVi; F. Taillandier, University of Bordeaux / I2M GCE; G. Sonnenmann, Université Bordeaux / ISM CyVi
Life cycle assessment (LCA) is now acknowledged as the worthiest methodology to evaluate environmental performance of whole system in a holistic way. Thus, it has been tempting to extend LCA into simple risk or safety management frameworks. However, there are issues that call for a more in-depth study. Given the high potential of using LCA as decision-making tool, some limitations have been identified: (a)uncertainties due to social and economic context and (b)system complexity. Agent-based models (ABM) are computational models for complex systems simulation. ABM is a bottom-up approach in which agents interacting between them can be defined, driven by behavior defined in simple rules. Coupling of ABM with LCA has a high potential to supplement LCA in some of its methodological weaknesses for better decision support. We carried out a literature review of papers combining LCA and ABM based on a set of criteria in order to understand to what extent can ABM enhance LCA at different stages. This review suggests that ABM has the capacity to (a) measure phenomena not only driven by economic or rational factors and (b) forecast emerging dynamics not analytically predictable. Therefore, coupling LCA and ABM is a promising approach to guide the design of products exhibiting dynamics mainly driven by human behavior and to support consequential analysis through its capacity to explore the effectiveness of different sustainable policy scenario. Coupling ABM&LCA can be done with different strategies (extension of LCA, hybrid analysis and complementary use) depending on the expected trade-off between consistency and flexibility. Hybrid analysis is adapted to most of situation since both methods can exchange data externally without impacting the other one. Extension of LCA with ABM leads to a consistent model in which LCA is embedded in ABM, which is particularly relevant for study requesting to take into account dynamic effects in the technosphere. Different degrees of coupling (hard-coupling, light-coupling and soft-coupling) are defined according to (a)data flow direction and (b)coupling dynamic. Higher the degree of coupling, the higher the computational time; therefore the use of hard-coupling should be limited to studies integrating feedback in adaptive decision-making process. This paper addresses some methodological guidelines on the way of creating a dynamic LCA, taking into account the scale of analysis, the accuracy in the models, the complexity of the situation and also the level of detail required.

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Characterization and management of excavated soil and rock
G. Mininni, CNRIRSA; A. Sciotti, F. Martelli, Italferr SpA
This paper describes some case studies relevant to management of excavated soil and rock (ESR) produced when tunnelling is performed using Tunnel Boring Machine with Earth Pressure Balance system (EPBs-TBM). ESR can be alternatively qualified as waste or as by-products depending on utilization conditions (in particular, certainly of further use) and on their characteristics (especially in terms of environmental and health protection requirements). Tunnels construction entails production of large quantities of ESR, up to several millions of tons. Their management as a waste certainly requires a huge amount of financial and environmental impact for the entity that owns the project in this area. However, with the 2009 directive 2008/98/EC a new framework for the characterization of ESR was introduced. This paper demonstrates, through the analysis of case studies, that with the new approach, a more efficient, eco-efficient or socially responsible management of ESR is possible. The characterization protocol used to distinguish waste from by-product, fast to reproduce, cost-effective, and it is worthwhile to be aware of aspects which have an influence on the overall sustainability. To make the characterization process feasible, the characterization studies carried out by the European H2020 research project ITERAMS. In the presentation, the developed approach will be discussed. The new circular economy package of the European Commission will push all the member states to move from linear to circular economy with consequent reduction of natural resource exploitation. ESR can be one of the important sector where the challenging objectives may be reached. Now in Europe does not exist a clear understanding of the legislative measures and technical rules needed to harmonize the ESR management. Protocols are needed for their characterization, including bunches, limit values of some contaminants should be fixed to consider ESR as by-products, the allowed treatments as normal industrial practice should be clearly stated. Current legislation may have a non-unique interpretation and therefore the operators are exposed to uncertainties. The general principles of fair competition inside Europe are totally disregarded.

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REALIZATION OF ROAD GALLERY: ADVANTAGES, CRITICALITY AND FUTURE PERSPECTIVES
A. Selleri, Autostrode per Italia / direzione tecnica; S. Fissiani, Spea Engineering S.P.A.
For those who choose to carry public works at the service of the territory, which are the motorway routes, it is essential that in all phases, from approval to the realization of the work, the respect of the pre-established times in the project and the relevant regulations is guaranteed. In fact, time is a factor that directly affects the costs of execution and, above all, the costs borne by the community, which, in the event of bureaucratic red tape, cannot benefit from the availability of a more efficient, safer and less impactful service. Even though the regulatory framework tends to introduce simplifications in procedures with the latest updates, there are rare cases where there are no burdens that often negate the positive effects of investments in technologies put in place to improve construction techniques, and increase the speed of completion. To the complexity inherent in the realization of linear works, which involve the excavation of tunnels and the consequent management of excavated soil, is added the paradox that, at equal environmental conditions, the adverse impacts are more significant in those cases, will dramatically impair the feasibility of civil work realization. In this paper the legislative framework of Italy, United Kingdom and France, regarding management of ESR is presented and compared, with attention to the characterization protocol used to distinguish waste from by-product. Moreover, some Italian and international case studies will be presented showing validated data, courtesy provided by important construction companies. Case studies will include information on management model of ESR, adopted treatments before final use (considered as normal industrial practice) and final destination. Different approaches clearly appear from this study: in the Northern part of Italy authorities have allowed to use the ESR as by-products while in the area of Rome management as waste prevails. Other cases such as Crossrail (the railway tunnel crossing London), Cityringen, (Copenhagen underground) and Le Grand Paris (Paris metro) will be discussed. The new circular economy package of the European Commission will push all the member states to move from linear to circular economy with consequent reduction of natural resource exploitation. ESR can be one of the important sector where the challenging objectives may be reached. Now in Europe does not exist a clear understanding of the legislative measures and technical rules needed to harmonize the ESR management. Protocols are needed for their characterization, including bunches, limit values of some contaminants should be fixed to consider ESR as by-products, the allowed treatments as normal industrial practice should be clearly stated. Current legislation may have a non-unique interpretation and therefore the operators are exposed to uncertainties. The general principles of fair competition inside Europe are totally disregarded.

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Management of the soil material produced by EPB-TBM: from experimental design to the excavation phase

S. Padulo, A. Martino, D. Putzu, ITALFERR S.p.A.

The use of foaming agents and additives is one of the fundamental factors allowing the correct use of the EPB-TBM (Earth Pressure Balance-Tunnel Boring Machine) for the excavation of underground works. On the other hand, their use must be carefully assessed in environmental terms, starting from the initial planning stages, in order to meet the requirements for the excavation process. The subsequent use of spoil materials must not pose risks for the environment and human health. During the environmental design of the project, it is therefore essential the development of a site-specific conditioning study for the management of excavation material. In fact, on the basis of the results obtained from the conditioning tests, it is possible to hypothesise a maximum dose of the required conditioning agents, which will constitute the reference for the environmental risk assessment in the context of a sustainable management of spoil materials. Anyway, the management of spoil materials produced from excavation by EPB-TBM is extremely complex and is based on numerous design assumptions, characterized by high levels of uncertainty: from the definition of the commercial products to be used and of the most suitable soil conditioning parameters, to the execution of analysis and tests to be performed (biodegradation and/or ecotoxicological), up to the methods of interpreting the results. The uncertainties connected to the experiments carried out during the design phase can be reflected in: differences in the operational protocols to be adopted during construction, unavailability of the approved project, consequent increase in time and costs to reiterate the site-specific experiments and the fact that the tested modular products will be unusable in other applications.

The environmental legislation on this field, clarifies only partially how to control and manage the substances contained in foaming agents and additives used for the excavation process by EPB-TBM. To overcome the design problem related to the interpretation or absence of regulatory reference limit values for the main substances contained in the additives, site-specific experiments were carried out in some projects, aimed at evaluating the eco-compatibility of the conditioned soils through biodegradation and ecotoxicological studies of the foaming agents.

445 Environmental effect of chemicals injected into the soil in mechanized tunnelling applications

G. Vilardi, DICMA La Sapienza / Department of Chemical Engineering Materials Environment; D. Sebastiani, L. Bavasso, S. Miliziano, L. Di Palma, Università La Sapienza; F. Carriero, R. Sorge, Astaldi

In recent years the management of the soils and rocks resulting from the mechanized tunnel excavation process, raised increasing concern in Europe. The necessity of using conditioned soils for the subsequent use of spoil materials generated during tunnel excavation activities has lead companies, governments and research groups to face economical, technical, logistical and environmental issues. The most widely used technique in mechanized tunnelling, named Earth Pressure Balance (EPB), requires the continuous injection of chemicals during the advancement of the machines to enhance the excavation activity. Depending on the excavated materials features, vapour pressure and the physical and chemical compatibility of conditioned soils are mainly based on the materials re-utilization as aggregate for concrete, for filling in civil engineering, fills for road, railway embankments or breakwater harbour dam, stabilization of slopes affected by landslide phenomena or through projects of landscape management. The lack of information about the environmental impact of these chemicals, introduced during the tunnelling process, may lead to remarkable economical impact of the spoil management. In order to avoid the unnecessary costs, the necessity to transport and dispose of the treated material. In the worst case, the uncontrolled chemical injection could lead to the production of several tons of hazardous waste, whose management might be significantly onerous in terms of cost and time. The University of Rome Sapienza and Astaldi started a joint research program with the aim of acquiring acknowledge, data and expertise in the use of chemicals currently used in the soil conditioning processes. This research program has led inevitably to deal with the environmental impact of different products. Preliminary experimental studies started to be performed, a large number of different product were considered, preliminar screenings on the chemical structure and properties of each compounds has been necessary and the physical and chemical features of pure products and their modifications were determined. The major component of this new product is a natural mineral widely distributed in the earth’s crust. It is virtually insoluble in water and has no known ecotoxicity. Specifically, there is an absence of toxic effects on two aquatic organisms (Danio rerio and Daphnia magna) and a demonstrated low risk to arthropods, earthworms and soil bacteria. In a recent study commissioned with an environmental consultancy, it was considered that excavated soil to be used with the product and deposited in a licenced waste facility would not pose a risk to the surrounding water environment. Compared with existing products it contains very low levels of synthetic chemicals, relying instead on the natural mineral component to stabilise foams by a completely different mechanism; one that is potentially less susceptible to the degrading influence of soils that can compete for the surfactants that are present in, and that stabilise conventional foamed products at an independent laboratory have demonstrated the good stability of the foams produced using the product (half-life measurements of water drainage), and confirmed that mixtures of the foam with fine and coarse grained soils have the desired consistency and cone slump behaviour for EPB tunnelling. A series of specifically developed tests reveal that the addition of foam substantially reduces adhesion of the finer grained soils to metal surfaces. In practice this will translate to a substantial reduction in the clogging potential of excavated clay in the TBM cutter head and soil conveyors, crucial for maintaining good advance rates. The new product will be attractive to those seeking to minimise the environmental impact of tunnelling projects.

Analysis and Fate of Emerging Contaminants in soils, water and plants under water scarcity (II)

446 Site-specific protocol to assess the environmental compatibility of spoil materials produced by EPB-TBM

A. Barra Caracciolo, National Research Council / Water Research Institute; P. Genni, National Research Council of Italy (CNR) / Water Research Institute; E. Beccaroni, National Health Research Institute / Health and Environment Department; L. Patrocleo, Water Research Institute-National Research Council / Water Research Institute

The increasing use of Earth Pressure Balanced Shields (EPB-TBMs) in the tunnelling industry has been due to their advantages over conventional excavation methods, such as continuous operation, safer working conditions, reduced damage at surface level and higher tunnelling speed. The performance of EPB-TBMs relies on the use of appropriate soil conditioning foaming agents containing water solutions of surfactants, mainly sodium laurel ether sulphate (SLES) and in smaller concentrations other additives. In accordance with the Italian legislation, spoil material from excavation processes can be re-used by-products when the chemical thresholds for organic and inorganic contaminants (e.g. heavy metals, hydrocarbons C<12; Italian Decree 120/2017) are not exceeded. However, there are currently neither SLES soil threshold limits in European and Italian legislation (Annex 4 of the Italian Decree 120/2017), nor comprehensive studies on its possible ecotoxicological effects on soil and water organisms. The ecological approach here reported, consisting of site-specific studies together with ecotoxicological tests performed on the real excavated soils, aims to fill the gap between the lack of threshold limits in soil and water for these multicomponent commercial products and the environmental protection. The studies are planned following a preliminary evaluation of the foaming agent treatment ratios to be used for the specific lithological characteristics of the excavated soils. Here we report the main steps of the environmental studies useful for producing a “Protocol for the assessment of environmental compatibility of the spoil material during the tunnelling in the construction site”. The aim of the protocol is to address engineering contractors and stakeholders (e.g. Railway and Motorway operators) on how to verify the environmental compatibility of excavated soil before putting it in the destination site. It is very important to highlight that the protocol (e.g. the ecotoxicological test selection) has taken into account the site-specific characteristics and the possible environmental exposure scenarios in order to protect ecosystems and human health.

447 Mineral-based soil conditioner for EPB TBMs: An environmentally friendly alternative

M. Greenhill-Hooper, Imerys / Performance Additives; H. Spengler, Imerys / Imerys Metalcasting; G. Collard, Imerys / Performance Additives; C. Egerton, Consultant / Tunnelling

A novel product, based on a natural mineral has been developed for use as a foaming agent and soil conditioning agent with earth pressure balance (EPB) tunnel boring machines (TBMs). It is available as readily water dispersible granules or pre-prepared aqueous suspension form and can be dispersed and diluted readily in water with low shear mixing. The resulting dilute suspension can be converted into a foam using an industrial foam generator, or by other mixing methods. It can be used with existing equipment found on EPB TBMs, without the need for further modifications and investments. The product contains a mixture of several tons of hazardous waste, whose management would not pose a risk to the surrounding water environment. Compared with existing products it contains very low levels of synthetic chemicals, relying instead on the natural mineral component to stabilise foams by a completely different mechanism; one that is potentially less susceptible to the degrading influence of soils that can compete for the surfactants that are present in, and that stabilise conventional foamed products at an independent laboratory have demonstrated the good stability of the foams produced using the product (half-life measurements of water drainage), and confirmed that mixtures of the foam with fine and coarse grained soils have the desired consistency and cone slump behaviour for EPB tunnelling. A series of specifically developed tests reveal that the addition of foam substantially reduces adhesion of the finer grained soils to metal surfaces. In practice this will translate to a substantial reduction in the clogging potential of excavated clay in the TBM cutter head and soil conveyors, crucial for maintaining good advance rates. The new product will be attractive to those seeking to minimise the environmental impact of tunnelling projects.

448 Quantification of Carbon Nanotubes in Complex Matrices: Possibilities of Electron Microscopy

R. Kage, A. Gogos, Eawag Swiss Federal Institute of Aquatic Science and Technology

Fascinating properties of Carbon nanotubes (CNTs) allow the development of novel materials with increased functionalities (e.g. reduced weight, increased strength). Nevertheless, CNTs do pose potential environmental and human health risks and reliable methods to quantify CNTs at low concentration in complex matrices are still lacking. The development laboratory has found a unique shape of the CNTs to quantify these materials in complex matrices. Multiwalled CNTs (IRMM 382) suspended in either ultrahigh quality (UHQ) water or in soil
extracts were directly centrifuged on transmission electron microscopy (TEM) grids, resulting in an even distribution of the CNTs on the grids. Samples were investigated with a scanning electron microscope (SEM, Magellan XHR 400, FEI) operated at an acceleration voltage of 20 kV in emersion mode and using a bright field transmission electron detector. A ridge detection algorithm implemented in the image processing software Fiji was used to detect and characterize individual CNTs in the TEM grid images. The number of CNTs was calculated based on the total length of all CNTs (provided by the ridge detection algorithm) detected on the images in combination with their thickness (20 nm), their density (1.4 g cm⁻³) and the well-defined volume of suspension that was centrifuged on the TEM grids. CNTs were well separated on the TEM grids and an increasing number of CNTs was observed with increasing concentrations of CNTs in suspension. Plotting the calculated concentration of CNTs in suspension against the nominal CNT concentrations (10 μg L⁻¹ ~ 100 μL⁻¹) resulted in a linear relationship. The calculated and the nominal CNT concentrations were in good agreement at low CNT concentrations, but at high concentrations, the calculated concentrations underestimated the nominal values by a factor of ~2. Almost identical results were obtained from CNTs in UHQ water and in soil extracts (5 μg CNT/g soil) indicating that the detection of the CNTs was not compromised by the presence of soil particles. Future experiments will focus on a selective removal of the soil particles by an additional treatment with diluted hydrofluoric acid. Initial experiments are promising and suggest that the detection limit of the methods can be lowered to 1 mg CNT/kg soil, which would represent huge step forward in detecting of CNTs in complex matrices.

449 Monitoring for perfluorinated compounds, insecticides, and brominated flame retardants in the water of Daechung lake and Geum river basin

H. Lee, National Institute of Environmental Research (NIER) / Geum River Water Environment Research Center; Y. Cho, J. Khan, National Institute of Environmental Research (NIER) / Geum River water environment research center; B. Lee, National Institute of Environmental Research NIER / Han river water environment research center; B. Seol, M. Chae, S. Cheon, National Institute of Environmental Research NIER / Geum River Water Environment Research Center A multiresidue analytical method using LC-MS/MS was developed for perfluorinated compounds (PFCs), insecticides, and brominated flame retardants (BFRs) in water samples with the simultaneous SPE method. The ranges of recoveries were 19.7 ~ 135.0 % (PFCs), 95.0 ~ 117.2 % (Insecticides), and 72.5 ~ 86.4 % (BFRs), with coefficients of variation of less than 15%. Method detection limit (MDLs) of PFCs, insecticides, and BFRs were 0.3 ~ 7.1 ng/L, 3.0 ~ 37 ng/L, and 5.1 ~ 11.7 ng/L, respectively while limit of quantifications (LOQs) were 0.9 ~ 21 ng/L (PFCs), 9.0 ~ 11.0 ng/L (Insecticides), and 15.4 ~ 35.0 ng/L (BFRs). For understanding the background levels of PFCs, insecticides, and BFRs in the river water, those compounds were monitored in Geum river main stream, So-ok stream, Juwon stream, and Daechung Lake (Dam) every month (March to December) utilizing the developed method. The compounds of the highest detection frequency were PFOS, PFHX, and dinotefuran (Insecticide), whereas BFRs were detected only in March and December, except for main stream. In conclusion, the trends were not observed on periodical and spatial characteristics and the background levels were secured for PFCs, insecticides, and BFRs in Geum river basin.

450 Impacts of Contaminants of Emerging Concern on Terrestrial Organisms

Stacia Dudley1, Marcus Pennington1, Chenliang Sun2, John Trumble1, Jay Gan2, John Trumble3, University of California, Riverside / Environmental Toxicology; M. Pennington, UC Riverside / Environmental Toxicology; C. Sun, UC Riverside / Environmental Science; J. Trumble, University of California, Riverside / Entomology; J. Gan, University of California, Riverside / Department of Environmental Sciences

Impacts of Contaminants of Emerging Concern on Terrestrial Organisms

Stacia Dudley1, Marcus Pennington1, Chenliang Sun2, John Trumble1, Jay Gan2, John Trumble3

Environmental Toxicology Graduate Program, University of California, Riverside, California Department of Environmental Sciences, University of California, Riverside, California Department of Entomology, University of California, Riverside, California Reclaimed water is a historically underutilized resource. However, with increased population growth and global climate change placing increased pressure on fresh water resources, reclaiming wastewater and recycling it allows for sustainable means to meet the needs of citizens, industries, and agriculture. The use of recycled water for agriculture comes with the potential risk of environmental and food contamination by contaminants of emerging concern (CECs). These compounds pose a potential threat to the health of ecosystems because they are designed to be biologically active at low concentrations and are considered “pseudo-persistent” due to their concentration in the environment for extended mass spectrometry. 14C tracing, enzyme extraction and Illumina sequencing techniques we evaluated a wide range of biological effects in terrestrial organism caused by exposure to CECs. Organisms in these studies included, the cabbage looper (Trichoplusia ni), an earthworm (Eisenia fetida), a model plant (Arabidopsis thaliana) and cucumbers (Cucumis sativus), radishes (Raphanus sativus L) and tomatoes (Solanum lycopersicum). These studies have revealed a multitude of effects including increased mortality and development time, reduction in weight, changes to the microbiome and up-regulation of enzymes associated with oxidative stress. Further, the study has highlighted the potential for higher plants to take up, translocate and detoxify CECs.

451 Occurrence of pharmaceuticals and their metabolites in Euthynnus alletteratus bile

J.M. Peña Herrera, Institute of Environmental Assessment and Water Research (IDAEA-CSIC) / Environmental Chemistry; N. Montemurro, IDAEA CSIC Barcelona / Dipartimento di scienze agro-ambientali e territoriali; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; J. Navarro, IDAEA-CSIC / Dept. Recursos marinos renovables; M. Solé, ICM-CSIC; S. Perez, IDAEA CSIC / Environmental Chemistry; D. Barcelo, IFAQ-CSIC / Department of Environmental Chemistry

The occurrence of pharmaceuticals in surface water has been attributed to the effluents of WWTP among others. The widespread occurrence of pharmaceuticals in the aquatic environment has raised concerns about their potential adverse effects on exposed wildlife. Little is currently known on exposure levels of drugs in fish, but some studies reported the detection of pharmaceuticals and endocrine disrupting compounds in this type of biota. Due to possible accumulation processes, pharmaceuticals and metabolites could be thousand times more concentrated in fish than in polluted living waters. By other hand, fish are known to possess a hepatic detoxification system which are likely capable of metabolizing pharmaceuticals taken up from polluted waters. Some studies proposed the analysis of bile from fish to evaluate pharmaceuticals exposure including the identification of metabolites by UPLC-HRMS. In this context, we propose the evaluation of the metabolism of frequently detected drugs in fish, performing a screening bile of by HR-MS for the presence of stable intermediates. Fish were collected from different regions in the Mediterranean coast of Spain. Afterwards, their bile was isolated from the fish and analyzed for the detection of parent drugs and some metabolites listed in an in-house suspected list. A sampling campaign was planned to collect tuna fish, Euthynnus alletteratus, from the Mediterranean coast of Spain. Tarragona, Barcelona, Càdiz, Tenerife, Menorca, Mallorca, and Faro. All samples were analyzed directly by UPLC-HRMS after a protein precipitation. The HRMS data allowed screening for suspected pharmaceuticals and their metabolites and provided plausible chemical formulae. The comparison of MS/MS spectra of the parent compounds and their metabolites allowed to propose chemical structures for possible metabolites in fish bile. With this analytical methodology some metabolites, corresponding to different reactions that includes products of hydroxylation, glucuronide conjugates were identified. The suspect analysis of bile samples allowed the detection of several pharmaceuticals. Psycho-active drugs were one of the most commonly detected drugs. Their identities were proposed by matching their accurate MS and MS/MS data against different libraries. Finally, authentic standards were employed to confirm the proposed drug identities and to determine analyze concentrations in the fish samples.

452 Accumulation and fate of 12 human drugs through the soil-root-leaf system

N. Montemurro, IDAEA CSIC Barcelona / Dipartimento di scienze agro-ambientali e territoriali; G. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; S. Perez, IDAEA CSIC / Environmental Chemistry; D. Barcelo, IFAQ-CSIC / Department of Environmental Chemistry

Crop irrigation with reclaimed water has become an extended practice in many countries worldwide where the water scarcity and excessive exploitation of agriculture are forcing local authorities to look for alternative resources. Despite this, it increases local water resources and contributes to nutrient recycling, using reclaimed water for irrigation, however, represents a primary source of emerging organic contaminants resilient to wastewater treatment processes, such as some pharmaceuticals and personal care products [1]. These pollutants can be retained in the soil, directly uptaken by crops or translocated from soil to plant tissues above the ground [2,3]. The present work aimed to evaluate the transfer and the biaccumulation of organic contaminants of emerging concern (mainly pharmaceuticals) in lettuce tissues and soil. The distribution of twelve relevant wastewater-derived pollutants was evaluated in lettuce tissues (leaves and root system) and soil. This list included nine prescription drugs (dilofenac, trimethoprim, carbamazepine, oxcarbazepine, lamotrigine, cis-diltiazem, valsartan, methadone and methadone), an illegal drug (cocaïne) and two transformation products (acetylcode and valsalart acid). Lettuce plants were grown in pots in a controlled environment and irrigated with artificial spiked water containing the 12 compounds during the entire growing period (60 days). Control was irrigated with tap water. Afterwards, a set of new lettuce plants were grown in the same soil pots and irrigated with rainwater or with tap water, if necessary. At the end of each growing season, lettuces (leaves and roots), soybeans, clover, lettuce, tomatoes, lentils, and millet were collected for analysis. All pharmaceutically active compounds were extracted by ultrasonic liquid extraction (USE) [4]. The detection of the target analytes was performed using liquid chromatography coupled to tandem mass spectrometry (LC-MS/MS). The results from the first growing season evidenced the presence of all analytes in all investigated matrices. Carbamazepine was the analyte that accumulated the most in lettuce plants (leaves and root system), whereas cis-diltiazem, methadone, and midazolam were preferentially accumulated in the plant root system and the soil. Concentrations of the target analytes in the plant-root-soil system after the second growing season were significantly lower than those measured after the first growing season.
season, but still detectable for most of the compounds.

453 Root-uptake and dissipation of atenolol, sulfamethoxazole and carbamazepine applied as a single compound solution or in mixture of all compounds in three soils and five plants

R. Koeck, J. Nording, J. Kristoufek, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; O. Golovko, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrogenoses; M. Fer, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; O. Koba, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrogenoses; M. Hrkač, A. Nikodem, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; R. Grabic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrogenoses

This study was focused on a root uptake of carbamazepine, atenolol and sulfamethoxazole from 3 soils: Haplic Chernozem, Haplic Cambisol and Arenosol Epiaortic. Five plants (radish, arugula, lettuce, spinach and green peas) planted in those soil were initially irrigated by fresh water and next with water contaminated by a single compound or their mixture. After 3 or 4 weeks, each plant was divided into separate parts: roots (including bulbs of radish), leaves, stems (green peas) and pods (green peas). Plant parts and soils were freeze-dried and dry-masses and concentrations of pharmaceuticals and their metabolites were measured. Despite that atenolol and sulfamethoxazole relatively rapidly dissipate from soils, they and metabolites of atenolol were detected in all plants. Carbamazepine is very stable in soils and fractions of its metabolites are usually low. However, very high concentrations in all plants were measured not only for carbamazepine but also for its metabolites. The degree of compounds’ transformation depended on a plant family. Considerably higher concentrations of atenolol, sulfamethoxazole and metabolites of atenolol were measured in roots in comparison to those in leaves and soils. In the case of carbamazepine, the highest concentrations were measured in leaves followed by roots and soils. Both indicate a high potential of plants to accumulate studied pharmaceuticals in their bodies and a high ability to transform studied compounds. Particularly in the case of carbamazepine, the considerably higher concentrations of metabolites were measured in leaves in comparison to concentrations in roots and very low or negligible concentrations in soils. Transformation of compounds in plant bodies is attributed to enzymes CYP450. Larger concentrations of carbamazepine metabolites were measured in leaves of lettuce, spinach and green peas than in leaves of radish and arugula (Order – Brassicales, Family – Brassicaceae). Oxcarbazepine was detected only in plants (metabolism type M0). The concentration of the metabolites was different for all tested plants. The impact of application (single compound versus compounds’ mixture) differed for different plants. Antibiotic sulfamethoxazole likely reduced dissipation of other two compounds in soils, which increased relative concentrations of compounds in plants (i.e., concentrations of compound in plant divided by compound loads in soils that is a total amount of applied solution divided by a dry mass of soil).

Prioritisation and Intelligent Testing of Pharmaceuticals in the Environment (II)

454 Inter-individual variation in the bioavailability and effects of NSAIDs in fish

A. Brown, Exeter University / Biosciences; L. Gunnarsson, University of Exeter / Biosciences; A. Lange; D. Rowe, The University of Exeter; M. Trznadel, University of Exeter / Biosciences; M. Linder-Nording, S. Gougoua, University of Umea; J. Wu, Umea University; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences

A basic tenet in the environmental risk assessment of pharmaceuticals is that pharmacological effects will occur in advance of any adverse effects, if their molecular targets are conserved in wildlife and if circulating blood plasma concentrations approach therapeutic concentrations established in humans. Fish generally display high levels of conservation of human drug targets and may be exposed to pharmaceuticals via discharges from wastewater treatment plants. The Non-Steroidal Anti-inflammatory Drugs (NSAIDs) ibuprofen and diclofenac are present in effluents, resulting in low mg/L concentrations in surface waters and fish blood plasma below or bordering on "therapeutic" concentrations. This has been supported by studies that link blood plasma concentrations as a measure of stress in fish, potentially affecting plasma NSAID and PG concentrations. From our analyses, no single factor could explain the observed variations in NSAID uptake and pharmacological response. Our data highlight some of the complexities in interpreting biological exposure and effects data for NSAIDs.

455 Environmental effect assessment of human pharmaceuticals - the regulatory way forward

J. Bachmann, German Environment Agency (UBA) / Section IV2.2 Environmental Risk Assessment of Pharmaceuticals; S. Schwarz, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals; U. Brandt, German Environment Agency UBA / Section IV Environmental Risk Assessment of Pharmaceuticals; I. Ronnefahrt, German Environment Agency - UBA / Section IV 2.2 Pharmaceuticals

Human pharmaceuticals are extensively studied and assessed before marketing approval. The EMA guideline for environmental risk assessment of human pharmaceuticals (EMEA/CHMP/SWP/4557/02) was adopted in 2006 and is currently under revision. Input has been provided by several stakeholders from academia, industry and government. In this context, the UBA experiences with effect based assessment of human pharmaceuticals will be evaluated and presented. The basis for the evaluation are double quality checked effect data of algae, aquatic invertebrates and fish provided within several European authorization procedures. Biological concentrations of human pharmaceuticals in water samples often resemble the human drug concentration in plasma and are therefore anonymous and encoded form. One discussion point will be the question whether the current base of data is sufficient to draw general conclusions. Although the results are based on more than 10 years of experience with environmental risk assessment within the authorization of new human medicinal products, the data basis is still lower than desired. So for some pharmaceutical ingredients detected in surface waters environmental effect data are lacking, because they entered the market before implementation of the EMA guideline. Furthermore, the tailored assessment approach for substances with very specific mode of action will be addressed, especially regarding the remaining uncertainties for protection of biodiversity and the environment. This does apply e.g. for endocrine active substances like contraceptive drugs. Furthermore, the evaluated data allow discussion about effect sensitivity of several taxonomic groups, as well as about the PEC action limit (10 ng/L) for effect data justification. The quotient between the effect values of most sensitive and most insensitive species in more than 20% of the evaluated cases is greater than 100. Fish are the most sensitive organism group in more than half of the cases. In this context, the proposed approach for fish replace long-term experience by short-term effects based as applied usually for chemicals without any specific mode of action will be analyzed.

456 Prioritising human health risk of environmental residues of pharmaceuticals and personal care products in use in southern Nigeria

U. Agusiegbu, Environment Department, University of York / Environment; C. Eze, UNIVERSITY OF NIGERIA NSUUKA NIGERIA; A. Boxall, University of York / Environment Department

Pharmaceutical and personal care products (PPCPs) are used worldwide for medical treatment and personal hygiene. PPCP residues are usually discharged into the environment during wastewater treatment. The environmental fate of these chemicals is poorly understood, leading to concerns about potential health effects and ecological impact posed by their use and release. In many developing countries, information regarding the consumption patterns of PPCPs is often limited, even though consumer product usage data are crucial for more realistic exposure estimates, like non-prescription drugs. Furthermore, the evaluated data allow discussion about effect sensitivity of several taxonomic groups, as well as about the PEC action limit (10 ng/L) for effect data justification. The quotient between the effect values of most sensitive and most insensitive species in more than 20% of the evaluated cases is greater than 100. Fish are the most sensitive organism group in more than half of the cases. In this context, the proposed approach for fish replace long-term experience by short-term effects based as applied usually for chemicals without any specific mode of action will be analyzed.
ciprofloxacin, ampicillin, cloxacillin, sulfamethoxazole, trimethoprim and pseudoephedrine) and 4 PCP (sodium lauryl ether sulphate, alcohol ethoxylates, ammonium thioglycolate and dichlorvos). This is the first attempt to prioritize PPCPs in Nigeria and it provides a useful priority set of chemicals for source water monitoring in the region. Future work will focus on evaluating the results of the prioritisation approach against real world monitoring data for Nigeria.

457 Aquatic toxicity related to pharmacological or secondary targets of human pharmaceuticals
A. Coors, ECT Okoekotoxologie GmbH; A. Falkenhain, C. Brüggegomm, ECT Okoekotoxologie GmbH; M. Scheurer, DGWV Water Technology Center / Analysis and Water Quality.

Human pharmaceuticals target specific biological structures to exhibit their intended therapeutic effect. The presence of the anticipated biological target of a pharmaceutical in a non-target species may lead to specific effects in that organism, while in the absence of the target the non-specific baseline toxicity such as narcosis would prevail. Yet, pharmaceuticals often do not only interact with the anticipated pharmacological target in patients, but can also interact with secondary targets. Hence, specific toxicity could occur in non-target species also in the absence of a conserved pharmacological target simply because the secondary target is conserved in that species. The present study explored this hypothesis testing anti-histamines as model substances in Daphnia magna and the green algae Raphidocelis subcapitata. 

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458 Neurotoxicity testing approach to investigate venlafaxine and oxazepam modulation of transcriptional and behavioral profiles in zebrafish embryos and larvae
C. Di Paolo, RWTH Aachen University / Ecosystem Analysis (ESA); M. Gundlach, RWTH Aachen University / Department of Ecosystem Analysis ESA; A. Haigis, Institute for Environmental Research, RWTH Aachen / Department of Ecosystem Analysis ESA; R. Hamann, Fraunhofer IME; S. Wuester, Institute for Environmental Research RWTH Aachen; M. Krauss, Helmholtz centre for Environmental Research - UFZ - Effect-Directed Analysis; M. Fenske, Fraunhofer Gesellschaft / Translational Medicine and Pharmacology; I. Werner, Ecotox Centre Eawag-EFPL - Department of Anatomy Physiology and Cell Biology; H. Hollett, RNA-Seq Center / Institute for Environmental Research.

Neuroactive pharmaceuticals are of growing concern as aquatic contaminants due to their neurotoxicity research and practical significance. The project aimed to contribute for establishing a neurotoxicity testing approach by investigating molecular (transcriptome) endpoints involved with neurotoxicity testing. The testing approach employs the zebrafish model (Danio rerio) and larva (up to 5 days post fertilization (dpf)) and submitted either to RMA, gill or gut provide a simple virtual fish alternative to live fish. These methods offer a critical step between predicting compounds of highest concern and prioritising which require further testing.

Emergence and multidimensional interactions of engineered nanoparticles in toxicology
460 Effects of fullerene C60 increasing concentrations in Mytilus galloprovincialis: role of mTOR in cellular/tissue alterations
S. Sforzini, Universita Del Piemonte Orientale Amedeo Avogadro / Department of Sciences and Technological Innovation (DiSIT); C. Oliveri, University of Piemonte Orientale / Department of Sciences and Technological Innovation DiSIT; A. Barranger, University of Plymouth / School of Biological Sciences; J. W. Readman, University of Plymouth / Biogeochemistry Research Centre; Y. Aminot, University of Strasbourg; A.N. Haas, Universitat / Biological Sciences; M. Banni, Laboratory of Biochemical and Environmental Toxicology; A. Viarengo, ICRCS Istituto di Ricerche Farmacologiche Mario Negri / Laboratory of Environmental Chemistry and Toxicology.

Little is known about the effects of fullerene C60 on organisms, and in particular on Mytilus galloprovincialis. The effects of C60 on mTOR (mechanistic Target of Rapamycin) activity in mussel digestive gland were studied. mTOR is an evolutionarily-conserved serine/threonine protein kinase that senses and integrates specific nutrient and cellular stress signals and provides not only simple information such as a compound may be taken up, but also rates of uptake and excretion. This data can be used to build kinetic models. The liver spheroïds provide a metabolic tissue that when used in co-culture with the gill or gut provide a simple virtual fish alternative to live fish. These methods offer a critical step between predicting compounds of highest concern and prioritising which require further testing.

459 Virtual fish tales: Liver, Intestinal and Gill Organoïds as an in vitro alternative to live fish for prioritising pharmaceuticals and other compounds of highest concern in the environment.
S. Osung, AstraZeneca / Safety Health Environment; L.M. Langan, Plymouth University / Biological and Marine Sciences; R.J. Maunter, Plymouth University / Biological Sciences; M. Baron, Plymouth University; A.N. Jha, Plymouth University / Biological Sciences.

Pharmaceuticals enter the aquatic environment largely through patient use, and result in a pseudo - persistent background in the aquatic environment. The risk of these compounds is assessed for non-product registered since there is a legacy of essential medicines for which we need to understand more. Since most of the thousand or so pharmaceuticals used by patients are likely to pose little environmental risk, it is important to identify those of most concern in order to prioritise effort and resources; it is vital to be able to predict internal concentrations in aquatic organisms. One method to assess uptake potential is to expose the animals of most concern. However, there are potentially thousands of compounds to be prioritised. Factoring that we already know the uptake rate can be influenced by the concentration of the compound in the water, there are enormous ethical implications for conducting this work with live animals (fish), and significant cost of resources to practically conduct the work. Alternatives are clearly required. Significant efforts to better predict environmental exposure are underway as part of the iPiE project (IM grant no.115735—iPiE). These in silico methods provide a first tier of screening, but we are likely still faced with hundreds of compounds to assess at multiple concentrations. We have been developing in vitro tissue micro-organs (organoids) that replicate the in vivo tissue. These can be used to build a virtual fish that will allow the screening of pharmaceuticals (or other compounds of concern or even metals) without testing live fish (BBSRC/NERC grant BB/L01016X/1). By building fish tissue cultures that better represent the complexity of the in vivo situation, we are able to offer in vitro models that can simulate live fish. Water exposure to the gill model can now be tolerated (without compromise) for several weeks, intestinal models are similarly robust. Since both methods employ a permeable barrier culture, rates of flux can be measured that provide not only simple information such as a compound may be taken up, but also rates of uptake and excretion. These data can be used to build kinetic models. The liver spheroïds provide a metabolic tissue that when used in-co-culture with the gill or gut provide a simple virtual fish alternative to live fish. These methods offer a critical step between predicting compounds of highest concern and prioritising which require further testing.
461 Protonic responses to nanoparticulate and ionic silver in freshwater microbes with different background
D. Barros, Universidade do Minho / Centre of Molecular and Environmental Biology, Department of Biology; A. Pradhan, University of Minho / Department of Biology; P.M. Santos, C. Pascoal, F. Cassio, University of Minho / Centre of Molecular and Environmental Biology CBMA Department of Biology. Enhanced use of AgNPs (silver nanoparticles) has inevitably resulted in their release into freshwaters raising concern about the risk to non-target biota and related ecological functions. Functional protonics is an emerging technology that provides high-throughput analyses augmenting measurements of direct and highly sensitive responses at the cellular and sub-cellular levels. The impacts of AgNPs and ionic Ag at EC50 (effective concentration) were assessed based on the variations in the overall protonome in two aquatic fungal strains of Articulospora terataludia, one isolated from a non-polluted stream (At72) and the other from a metal-polluted stream (At61), and ii) the bacterial strain Pseudomonas sp. M1 (PsM1) isolated from a metal-polluted stream. At72 was the most sensitive to AgNPs, whereas PsM1 was the most tolerant one. Characterization of AgNPs showed increased particle stability and lesser agglomeration with time in At72 while for At61 and PsM1 there was an increase in AgNPs agglomeration explaining its lower impacts on their growth. In fungi, ~40% of the total quantified proteins were significantly altered after exposure to AgNPs and/or Ag+ whereas for PsM1 this percentage was lower (~20%). At72 and At61 shared only 20% of the proteins suggesting that the biological pathways involved in Ag+ and AgNPs exposure were different. At61 had ~25% more proteins induced by both Ag forms (compared to At72), suggesting higher response which is consistent with the background of this fungal strain. In PsM1, 32% of the proteins increased under exposure to AgNPs whereas the percentage for Ag+ was higher (68%) indicating different responses to Ag+ and/or AgNPs. In At72, Ag+ increased the content of proteins involved in protein homeostasis while AgNPs increased the content of proteins related to DNA repair, the transport of substances and energy production. In At61, AgNPs increased the content of proteins involved in protein synthesis and energy production while both forms of Ag increased the content of proteins related to cell-redox and protein homeostasis, biomass and spores production and also to nucleic acids metabolism. Both Ag forms induced stress-responsive proteins which was consistent with the responses of enzymes involved in oxidative stress. Overall, functional protonics can be useful to get a mechanistic insight on the stress induced by AgNPs and/or Ag+ in microbes that play key roles in freshwater ecosystems.

462 Hazard assessment of seven different commercial silica nanoparticles on a battery of test species: bacteria, algae and fish cell lines
F. Lomnari, University of Osijek / Department of Biology; D. Markovic, University of Osijek / Department of Biology; D. Lonnar, University of Osijek / Department of Biology; D. Markovic, University of Osijek / Centre of Molecular and Environmental Biology CBMA Department of Biology. Manufactured silica nanomaterials are widely used in numerous applications in society such as paints, coatings, cosmetics, textiles and food and its release into the environment is to be expected. This has raised concern regarding the risk of silica nanomaterials and was in 2010 selected as one of the priority substances by the OECD Working Party on Manufactured Nanomaterials. In order to thoroughly examine the toxicity of silica nanomaterials to deuterans, primary producers and fish, a panel of seven well characterized (with different size, coating and charge), biocide free, silica nanomaterials, were tested on bacteria, algae and fish cell lines. Based on the result, the current study also examined the selection of an appropriate exposure metric comparing mass (mg/L), number of particles (No/L) and surface area (m²/L) against the observed toxicity. The results show that gill cell lines were the most sensitive test model with the lowest reported EC20 value of 5.1mg/L after exposure to the smallest particle at a concentration range of 12.5-100mg/L. Toxicity to fish cells was determined to be surface dependent, except for particles coated with ethoxy silane, which did not show surface specificity. For bacteria and algae, the cell wall seems to play a major role in the uptake and toxicity of silica nanoparticles. Keywords: hazard assessment, silica nanoparticles.

463 Toxicity Assessment of Engineered Titanium Dioxide Nanoparticles
S. Bitragunta, Birla Institute of Technology & Science Pilani, Hyderabad Campus / Biological Sciences; S. Palani, Birla Institute of Technology & Science, Hyderabad Campus / Biological Sciences
Titanium dioxide engineered nanoparticles (TiO₂-ENP) are extensively employed in manufacturing of cosmetics, pharmaceuticals and health care products. As a result, TiO₂-ENP can reach the ultimate sink such as soil in the environment during their life cycle. In this context, investigations to understand environmental implications of nanoparticles including TiO₂-ENP are gaining prominence across the globe. In the backdrop of assessment toxicity of rutile TiO₂-ENP (r-TiO₂-ENP) in soil sentinel, present study is aimed at evaluating their toxicity as per OECD-207 guidelines on earthworm, Eisenia fetida. Physicochemical characterization of r-TiO₂-ENP using dynamic light scattering revealed their tendency to form agglomerates (330-480 d.n.m) in water. Soil exposure of earthworms to r-TiO₂-ENP (0.1, 0.15, 0.2 and 0.25 mg/kg) showed no mortality after 48 h. Increased specific activities of antioxidant enzymes including catalase, superoxide dismutase and glutathione peroxidase as well as lipid peroxidation indicate the potential of r-TiO₂-ENP to induce oxidative stress in the sentinel organism. Interpretations of the study can serve as cues to design a comprehensive approach for developing invertebrate based biomarkers and indicators as early warnings for assessing environment and health impacts of engineered nanoparticles.

464 Combination effects of chlorpyrifos and ZnO on oxidative stress and reproduction of the earthworm Dendrobaena veneta
D. Hackenberger, Department of Biology, University of Osijek / Department of Biology; L. Limanic, University of Osijek / Department of Biology; D. MarkovicDz, University of Rijeka / Department of Biotechnology; G. BodoDz, Radjer Boskovic Institute; B. Hackenberger, Department of Biology, University of Osijek / Department of Biology
When assessing the toxicity of pesticides and other chemicals to non-target organisms the most common experimental set-up is an exposure to a single compound. However, it is more likely for organisms under the environmental conditions to be exposed to a combination of ZnO and chlorpyrifos (CHP) on biochemical biomarkers and reproductive success of the earthworm Dendrobaena veneta with possible differences in effects of ZnO in nano and bulk form, and the difference of effects in various soils. EC50 values for reproduction of D. veneta after exposure to CHP and ZnO were calculated and used in the binary toxicity experiment. Concentrations were as follows, with EC50 being 100%: 100% CHP 75% CHP/25% ZnO, 50% CHP/50% ZnO, 25% CHP/75% ZnO, 100% ZnO. ZnO was separately tested as bulk and nano sized particles and CHP was tested as a commercial preparations. The entire experiment was conducted according to the OECD earthworm reproduction test. At the end of the experiment the number of juveniles and activities of AChE, CAT, GST, TBARS, MT and PC were measured. The concentrations of pesticides in soil samples were measured with UPLC and the concentrations of Zn was measured with the energy dispersive x-ray fluorescence technique (EDXRF). CHP had a clear effect on AChE activity with almost 50% inhibition after 28 days of exposure in artificial soil. CAT activity did not change on any concentration, for both ZnO and ZnO, while GST activity decreased. The number of juveniles was significantly reduced with all mixture ratios. In natural soil CAT activity was also unaffected with bZn, and slightly induced with nZn/OCHP combination. The inhibition of AChE was present at all applied combinations. In natural soil the number of juveniles was reduced with nZnO, while it remained the same as control after bZnO exposure. The effects of combined exposure of CHP and ZnO varied depending on the concentration of ZnO and the characteristics of the soil in which the earthworms were exposed. More biomarkers should be employed to elucidate which low level biomarker can be linked with the effects on the higher (reproductive) level.

Improving the environmental risk assessment of the aquaculture 'Blue Revolution'

465 Poster spotlight: WE305, WE323, WE324

466 Tools for Assessment and Planning of Aquaculture Sustainability (TAPAS) P. van den Brink, Alterra and Wageningen University; A. Lillcrap, NIVA Norwegian Institute for Water Research / Ecotoxicology; A.L. Macken, Norwegian Institute for Water Research, NIVA; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; T.C. Telfer, University of Stirling Aquaculture is a major food production subsector which will play a major role in filling the growing seafood supply gap, estimated to be of the order of 47.5 million tons by 2050. However, aquaculture cannot be practiced everywhere; it requires a site to be exposed to a combination of chemicals that have different modes of action and potentially can interact with each other. The aim of this research was to investigate the effects of a mixture of ZnO and chlorpyrifos (CHP) on biochemical biomarkers and reproductive success of the earthworm Dendrobaena veneta with possible differences in effects of ZnO in nano and bulk form, and the difference of effects in various soils. EC50 values for reproduction of D. veneta after exposure to CHP and ZnO were calculated and used in the binary toxicity experiment. Concentrations were as follows, with EC50 being 100%: 100% CHP 75% CHP/25% ZnO, 50% CHP/50% ZnO, 25% CHP/75% ZnO, 100% ZnO. ZnO was separately tested as bulk and nano sized particles and CHP was tested as a commercial preparations. The entire experiment was conducted according to the OECD earthworm reproduction test. At the end of the experiment the number of juveniles and activities of AChE, CAT, GST, TBARS, MT and PC were measured. The concentrations of pesticides in soil samples were measured with UPLC and the concentrations of Zn was measured with the energy dispersive x-ray fluorescence technique (EDXRF). CHP had a clear effect on AChE activity with almost 50% inhibition after 28 days of exposure in artificial soil. CAT activity did not change on any concentration, for both ZnO and ZnO, while GST activity decreased. The number of juveniles was significantly reduced with all mixture ratios. In natural soil CAT activity was also unaffected with bZn, and slightly induced with nZn/OCHP combination. The inhibition of AChE was present at all applied combinations. In natural soil the number of juveniles was reduced with nZnO, while it remained the same as control after bZnO exposure. The effects of combined exposure of CHP and ZnO varied depending on the concentration of ZnO and the characteristics of the soil in which the earthworms were exposed. More biomarkers should be employed to elucidate which low level biomarker can be linked with the effects on the higher (reproductive) level.
aquaculture by developing tools, approaches and frameworks to support EU Member States in establishing a coherent and efficient regulatory framework, implementing the Strategic Guidelines for the sustainable development of European aquaculture and delivering a technology and decision framework for sustainable growth. The ultimate goal of the project is to create cost-efficient management tools and practices for the European aquaculture sector to investigate the scope of fish farming activity, social interactions, potential environmental impacts and any future risks.

467 Preliminary investigation on the occurrence of multifunctional organic micropollutants in offshore seawater and fish farm L. Liu, National University of Singapore; Q. Gu, National University of Singapore / Civil & Environmental Engineering

Limited research has been conducted on the occurrence and distribution of antibiotics, pharmaceuticals, personal care products, endocrine disrupting chemicals and artificial sweeteners in the marine environment despite being increasingly impacted by these micropollutants (MPs). In this study, the presence and distribution patterns of multifunctional organic micropollutants in 14 different groups were investigated in offshore seawaters and fish farms of Singapore. The sampling area is affected by various anthropogenic pressures including treated effluents, fish farming, shipping and port activities. A total of 23 MPs were found in offshore seawaters, 9 of them with detection frequencies higher than 50%. The highest detected values corresponded to cyclamate, salicylic acid and sucralose, with concentration range of

468 Perspectives on Urbanization, Water Reuse, and Aquaculture Product Quality

B. Gonzalez, Baylor University / Dept of Environmental Science; J.L. Conkle, Texas A&M University Corpus Christi / Physical and Environmental Sciences

By 2050, it is estimated that global food production must increase by 50%. Aquaculture will play an important role to meet these needs. For example, in 2014 aquaculture surpassed global fisheries in providing fish for human consumption. It is important to note that global aquaculture activities can in urban and periurban regions with differential waste management capacity. Yet high population densities in urbanizing regions result in concentration of food, energy, water and other resource consumption. Urbanization also leads to concentration of chemical use, which inherently results in exposures to human populations and ecosystems receiving waste streams within and from these urban centers. In developing nations, where many of the megacities will continue to emerge over the next few decades, aquatic products is occurring faster than public health interventions and environmental management systems are being implemented. Unfortunately, 80% of the global sewage production is not treated, but returned to the environment and thus reused for various purposes. These non-traditional reused waters are being recycled for agriculture, including aquaculture in areas experiencing rapid urbanization, yet implications for water security, food safety and international trade are not routinely examined to manage more sustainable aquaculture practices. In the current presentation we draw from our ongoing efforts in Asia and North America to understand bioaccumulation of organic contaminants of emerging concern in common fish and shellfish used for aquaculture. For example, we have observed aquacultured bivalves to accumulate diverse contaminants of concern (e.g., pharmaceuticals, pesticides, flame retardants), apparently from landfill leachates and effluent discharges of marginal quality, in Hong Kong. Our findings from laboratory uptake and depuration studies with channel catfish and tilapia focus on contaminants with diverse physico-chemical properties (e.g., weak base medicine, phosphorus-based flame retardant, perfluorinated compound, cyanotoxin) and provide an approach to improve aquaculture practice and to support bioaccumulation assessments for chemicals falling outside of applicability domains for nonionizable organic contaminants. In North America we are examining intersections among water reuse practices and aquaculture for various products. Such efforts appear warranted at the global scale.

469 Bioaccumulation of selected veterinary medicines in the blue mussel (Mytilus edulis)

S. Brooks, NIVA / Ecotoxicology and Risk Assessment; B. Belyich, NIVA; A. Ruus, NIVA / NIVA; J. Rundberget, NIVA; A. Lillicrap, NIVA / Ecotoxicology and Risk Assessment

Veterinary medicines are widely used within the fish farming industry for the control of sea lice infestation. In 2016, over 10 tonnes of veterinary medicines were used by Norwegian fish farms for the control of sea lice. The impact on non-target species has raised increasing concern. For instance, do wild and farmed mussels in the vicinity to these fish farms have the potential to bioaccumulate these chemicals and thereby pose a threat to human health? On the other hand, mussels may be the most suitable biomonitoring species for the presence of veterinary medicines in the environment. To better understand these scenarios, and the fate of these chemicals in the environment, a series of laboratory controlled exposures were performed to determine the bioaccumulation and depuration of selected veterinary medicines in the blue mussel (Mytilus edulis). The veterinary medicines included ttefurbenuron, emamectin, deltamethrin and azamethiphos. Due to the low solubility of ttefurbenuron and deltamethrin a saturation column was employed within a flow-through system to deliver a stable concentration of test chemical over a 14-day uptake phase. Water and mussel samples were collected at time intervals during the 14-day uptake phase, and again following transfer of the mussels into clean flowing seawater during the 7 to 14 day depuration phase. The effects of salinity on the bioaccumulation of ttefurbenuron also indicated that other mussels in brackish waters show different bioaccumulation dynamics. So far, our results have shown a clear uptake of ttefurbenuron over 14 days, reaching maximum concentrations (~1500 ng/g) after 10 days. Depuration of ttefurbenuron was fast for the first 2 days, although still present at approximately 250 ng/g after 7 days depuration. Salinity had no apparent effect on the bioaccumulation of ttefurbenuron. In contrast, emamectin showed low bioaccumulation, with maximum concentrations of 45 ng/g after 6 days. No significant depuration of emamectin was observed after 7 days in clean flowing seawater. The results suggest that mussels are a suitable biomonitoring species for the presence of veterinary medicines in the environment. Additionally, mussel farms in close proximity to fish farms have the potential to bioaccumulate these chemicals in their tissues and is subsequently recommended for monitoring.

470 Contribution of nuclear applications to better understand bioaccumulation of contaminants in aquaculture species

M. Metian, IAEA-EL / Radioecology Lab; S. Pouil, F. Oberhansli, International Atomic Energy Agency / Enviroutmental Laboratories; P. Bustamante, Universidad de La Rochelle / Littoral ENVironnement et Sociétés LiEnSSs; P. Swarzenski, International Atomic Energy Agency / Radioecology Lab

Environmental pollution from aquaculture is often seen as a major concern, but today, increasingly is the potential exposure of aquaculture to contaminants. In order to fully understand the contamination risk of farm-raised species, nuclear applications can be used. This powerful tool permits the susceptibility of economically important species (fish and seafood) to be contaminated. Marine fish farming is regarded as the future of aquaculture and thus, the safety of these farm-raised fish is paramount particularly as 50 % of fish consumed are now farm-raised. Therefore, a better understanding bioaccumulation processes of such contaminants with current aquafarming practices is essential. Such work will attempt to better understand the role the fish food or key environmental parameters on contamination of fish that may affect the health of the farmed species and/or the human consumer. This has been commonly done in a natural setting but is now beginning to be examined for fish farming practices. Major advantages of radiotrace techniques over conventional techniques are their very high sensitivity and discrimination capacity; it permits the measurement of bioaccumulation kinetics of several elements at realistic (viz. low) environmental concentrations in a single experiment. Furthermore, some radiotracers permit the non-destructive analyses of contaminant levels in living organisms. This paper identifies present and future threats on farm-raised fish from a contamination point of view, and presents a synthesis of experimental results completed on farm-raised fish using radiotracer to contaminants in realistic environmental conditions. It revealed, for example, the various effects that food, water salinity and temperature can have on the Assimilation efficiencies of trace elements and radionuclides in farmed fish. Such findings paving the way for further investigations on the potential use of nuclear techniques in aquaculture and food safety.

471 Effects of antibiotic’s medicated fish feed in the marine environment

B. Gonzalez-Gaya, IMDEA Water (GB4912732) / Environmental Chemistry; N. Garcia Bueno, I. Gomez, B. Martinez-Lopez, P. Franco, University of Murcia / Ecology and Hydrology; E. Buelow, Limoges University / Medicine Faculty, Inserm Umr 1092; A. Marn, University of Murcia / Ecology and Hydrology; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology

Intensive aquaculture is considered to be an important source of antibiotics into the marine environment. Antibiotics used in aquaculture have been reported to accumulate on sediments and non target aquatic organisms, modifying the biodiversity and the environmental conditions in areas close to fish farms. Moreover, recent studies have shown an emerging presence of resistance genes in environmental bacteria next to fish farms, which indicates the assembly, selection and dissemination of antimicrobial resistance through open aquaculture installations and might thereby compromise environmental and human health. A field experiment was performed in a moderately impacted bay in the south east coast of Spain (Aguilas, Murcia), which consisted of a series of sediment traps (covered or not covered with local sediment) and fish cages medicated or medicated with three antibiotics (oxytetracycline, florfenicol and flumequine). Fish feeds were applied simulating fish farm loses for a period of 3 weeks. Measured antibiotic concentrations in the sediment were 2700 – 8000 ng/g (average 1% of the applied amount) for oxytetracycline, and 19000 – 54000 ng/g (average 10% of applied amount) for flumequine. Florfenicol was not detected. Different accumulation rates were found in covered/uncovered traps due to wild fish influences in the availability of feed and bioturbation. Physico-chemical characteristics of the sediment also changed; with a higher S and lower N content and a larger percentage of fine material in feed affected treatments. Invertebrate
presence was also correlated with the food availability, although no evident effects of the antibiotics were found over the analyzed samples. Bioaccumulation of the antibiotics in the invertebrate community and evaluation of the antibiotic resistance mechanisms for selected chemicals (e.g. acrylamide, arsenic, citalopram, imidacloprid) showed that the exposure to the mixture showed little or no effect. These findings we exposed to low chronic toxicity concentrations of a fish species to understand the molecular basis for adverse outcomes is not easily interpreted from classical toxicology methods. Here we present the systems toxicology approach that focuses on deciphering biological mechanisms responsible for adverse outcomes. The underlying structure of this approach is a computable biological network model. We have developed two models describing molecular pathways that lead to cardiotoxicity and neurotoxicity in zebrafish larvae based on the knowledge curated from scientific literature. Key signalling nodes in the model are linked to information about downstream gene expression. Differential expression of downstream genes can be used to infer activity of the upstream protein – a process termed network scoring. Scoring of the network highlights the most affected nodes, which leads to mechanistic hypothesis generation and gives a quantifiable measure of network perturbation. In parallel to network scoring, we utilize classical toxicology methods to detect adverse outcomes. We present the acute toxicity results for selected chemicals (e.g. acrylamide, arsenic, citalopram, imidacloprid) according to the OECD fish embryo acute toxicity test (OECD test guideline 236). We then report results from chemically exposed larvae in functional cardiac and behavioural assays, and transcriptomics analyses. Finally, we describe the utility of the model network in interpreting transcriptomics analyses to gain mechanistic insight into the molecular events initiated by a given chemical. Cardiac and neural apical endpoints together with computational network scoring provide a comprehensive method for linking molecular events to organ toxicity. This approach will enable more accurate toxicity predictions over long exposures and in different species.


A major goal in the field of toxicology is to predict long term animal health risks and/or environmental hazards associated with a particular substance(s). Traditionally utilised classical toxicology methods involve animal exposure over a relatively short period and recording adverse outcomes. These data are then extrapolated to humans and to other species. The accuracy of such extrapolation would benefit from mechanistic understanding of toxicity. However, molecular basis for adverse outcomes is not easily interpreted from classical toxicology methods. Here we present our systems toxicology approach that focuses on deciphering biological mechanisms responsible for adverse outcomes. The underlying structure of this approach is a computable biological network model. We have developed two models describing molecular pathways that lead to cardiotoxicity and neurotoxicity in zebrafish larvae based on the knowledge curated from scientific literature. Key signalling nodes in the model are linked to information about downstream gene expression. Differential expression of downstream genes can be used to infer activity of the upstream protein – a process termed network scoring. Scoring of the network highlights the most affected nodes, which leads to mechanistic hypothesis generation and gives a quantifiable measure of network perturbation. In parallel to network scoring, we utilize classical toxicology methods to detect adverse outcomes. We present the acute toxicity results for selected chemicals (e.g. acrylamide, arsenic, citalopram, imidacloprid) according to the OECD fish embryo acute toxicity test (OECD test guideline 236). We then report results from chemically exposed larvae in functional cardiac and behavioural assays, and transcriptomics analyses. Finally, we describe the utility of the network model in interpreting transcriptomics analyses to gain mechanistic insight into the molecular events initiated by a given chemical. Cardiac and neural apical endpoints together with computational network scoring provide a comprehensive method for linking molecular events to organ toxicity. This approach will enable more accurate toxicity predictions over long exposures and in different species.

473 Time response relationship between gene expression and life history in a Daphnia population exposed to heavy metals L. Asselman, I. Semmouri, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology GheToxLab unit; K. De Schampaeleere, Ghent University (UGent) / Applied Ecology and Environmental Biology

Over the last decade, molecular technologies have evolved into robust high throughput platforms available to many scientists in a wide variety of disciplines. Implementation of these technologies in ecotoxicology and risk assessments have focused on mechanisms of toxicity and stress response on the gene level to explain effects at the organism level. However, current studies remain focused at the individual level and rarely include population level molecular responses. Population level molecular responses may provide a better insight into the potential mechanisms at play at the population level while at the same time avoid focusing on gene expression patterns that are the cause of clonal or interindividual variation. Furthermore, most studies select an arbitrary time point at which a quantifiable gene expression response without any prior knowledge. Here, we focus on population level responses of a Daphnia magna population to arsenic and copper and their binary mixture. The population was exposed to low chronic toxicity concentrations of arsenic and copper resulting primarily in effects on reproduction rather than survival. Rather than focusing on a single arbitrary time point, gene expression data and life history data were both recorded at multiple time points. As such, these datasets will provide a first basis on how exposure duration may affect the conclusions and decisions made about the toxicity of chemicals. In addition, by collecting both molecular data and life history data, we will be able to better understand the time response relationship in populations under stress both at the life history level and the molecular level. This will allow us to better integrate these two data types and identify potential causal relationships between the molecular level and the life history level. The identification of such causal relationships will play an integral part of incorporating omics data in environmental risk assessment.

474 How to implement functional responses of microalgae in risk assessment processing? E. Gras, Helmholtz Center for Environmental Research - UFZ GmbH; E. Billor, Universität de Lorraine, CNRS UMR 7360; S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology; M. Delignette-Muller, VetAgro Sup / Laboratory of Biometry and Evolutionnary Biology; M. Schmitt-Jansen, UFZ - Helmholtz Ctre Environm. Research / Department of Bioanalytical Ecotoxicology

Microalgae (e.g. bacteria, fungi and algae) are involved in various ecosystem functions such as biogeochemical cycles or pollutants degradation meaning that they are crucial for ecosystem functioning. In the environment, organisms are exposed to anthropogenic pressures which are known to potentially induce structural and functional changes. If such causal links are identified, little is known about the involved biochemical pathways supporting specific functions. Moreover, most of a priori ecological risk assessment (ERA) tools are based on structural endpoints and do not necessarily ensure the protection of these functions. The recent raise of OMICs approaches (e.g. transcriptomics and metabolomics) opens the perspective in ecotoxicology to explore pathways involved in ecological functions. The main aim of this study was to provide a new and innovative risk assessment tool based on functional responses (captured via OMICs approaches) of microalgae in the environmental context. The rationale to use OMICs in such context is to provide more protective and early warning thresholds. The transcriptomic and the metabolomic responses of Scenedesmus vacuolatus to triclosan were explored after exposure of 14 hours along an increasing gradient of 5 concentrations (from 0.69 to 6.63 µg/L, 5 replicates). Within a dedicated workflow, we selected the responsive molecular items (metabolites/transcripts) to which the concentration responses are linked (each of them and we derived a sensitivity value from each curve (even the non-montonic one). Molecular items showed mainly non-sigmoid and even non-monotonic responses to triclosan exposure. For example, the transcripts data were mainly best described by an exponential model for more than half of the curves and a Gaussian or log-Gaussian model for more than a quarter of the curves. Then, the molecular items were linked (when possible) to the pathways they are involved in. From that information, we built a SSD-like tool based on functional responses captured at the community level in order to protect functional traits and integrating two levels of OMICs responses. The next step consists to build such tool from the periphytic community level.

475 Sex, drugs and Daphnia magna. A multi-omics approach suggests conserved mechanisms of interaction between metallohormones and endocrine disruptors E. Casamano-Gutierrez, University of Liverpool / Computational Biology Facility; P. Ethorctic communities (U Liverpool / Institute of Integrative Biology; L. Suhas, The University of Birmingham / School of Biosciences; K. Gruntzalis, The University of Birmingham; M.R. Viant, University of Birmingham / School of Biosciences; F. Falciani, University of Liverpool / Institute of Integrative Biology The assessment of environmental exposure to toxic chemicals released by human activity as well as their impact on biological systems is key to protect the biosphere. Current ecotoxicological methods based on single endpoints are limited in providing mechanistic hypothesis and assessment of biodiversity. Although this has been a very effective strategy, it has some shortcomings. These include the fact that a relatively limited number of compounds can be measured and linked to biologically relevant organism-level responses. The issue is particularly challenging in chronic exposures and in complex mixtures scenarios. This project aims at identifying the molecular networks linked to single and mixture exposures and to use these to infer the effects of chemical mixtures. We approached this important challenge by applying a systems biology approach to integrate expression profiling, metabolomics and phenotypic data (respiration and feeding rates), representing the response of Daphnia magna to a panel of environmentally relevant chemicals and their mixtures. Firstly, it was exposed to a battery of single compounds with known mode of action (MoA) i.e. estrogen disrupters and acetylcholine esterase (AChE) inhibitors as well as metals with unclassified MoA. We have been able to model the differences between the two main MoA studied and linked them to biological activities within Daphnia. Furthermore, we have found that as expected, metals do not show a common MoA, with some of them clustering closer to either endocrine disrupters (E) or AChE inhibitors (Cd), whereas the remaining metal disrupters, has already been shown to play a role with the estrogen receptor in humans but its role in D. magna is still under surveillance. To further study this finding we exposed D. magna to complex mixtures of Cd and ethinylestradiol. While the individual exposures triggered the alteration of expression of a relatively large number of genes, the exposure to the mixture showed little or no effect. These results indicated that both compounds share a complex interaction at a molecular level suggesting that the degree of conservation of the regulatory pathways underlying response to endocrine disrupters may be higher than previously thought. Overall, our work shows that it is possible to predict a compound MoA from its...
molecular state and also predict additive or synergistic effects of mixture exposure.

476 Data-driven systems biology approach gives insight into a complex process of water remediation.

J. Kronberg-Guzman, The University of Birmingham / School of Biosciences; T.D. Williams, University of Birmingham / School of Biosciences; A. Mark, Wageningen Agricultural University / Dept of Toxicology; E. Foekema, Wageningen IMARES; R. van der Oost, Waternet / Onderzoek en Advies; K. Chipman, University of Birmingham; F. Falciani, University of Liverpool / Institute of Integrative Biology.

Introduction. Increasing population and industrial production put strain on clean water resources. Even in highly developed countries with advanced waste water treatment plants, water quality could be improved further before releasing it. Constructed wetlands have been used for water treatment for decades and are a low-cost natural option. Waterharmonica is an example of such additional treatment, consisting of a sedimentation pond, reed bed and a wetland forest. In this work, we have used three-spined stickleback living in mesocosms containing water from various stages of additional remediation from three different sites in the Netherlands. Aim. The aim of this work was to understand the effects of additional steps of water remediation. Results. We have used a data-driven systems biology approach to understand the relationship between the environment (chemical concentrations), molecular high-throughput measurements (stickleback liver gene expression), physiological parameters and more traditional measures of toxicity. We first integrated all different measurements into static similarity networks and modularised these so that in each module, genes are responding in a similar way during different stages of remediation. We see that some chemicals with high chemical risk (aldicarb, chlorpyrifos, fluoranthene, pirimiphos methyl) decrease in all sites and are also correlated with gene expression in both male and female stickleback. However, some chemicals are only correlated with gene expression in one sex or male of female stickleback. We also see that some chemicals for which predicted no-effect concentration (PNEC) is not known (such as PCBs and mineral oils) are associated with modules containing several high-risk chemicals.

Functional annotation reveals further insights. For example a module of the male stickleback network correlated with liver weight and several chemicals including triclosan and phthalates has a statistically significant number of genes from the KEGG pathway „metabolism of xenobiotics by cytochrome P450”. However, a module in the male-specific network that is not correlated with any chemicals, is enriched in KEGG functions related to immune functions („antigen processing and presentation”; „type I diabetes mellitus” and „cytokine-cytokine receptor interaction”). Conclusion. We have showed the potential of data-driven systems biology approach integrating various types of data to give insight into the effects of a complex remediation system.

477 Co-expression network analysis of massive proteogenomic data: applications in ecotoxicology.

D. Deligiannis, University of Louvain-la-Neuve / Dept of Toxicology; K. J. Lusta / UR RIVERLY Laboratoire Ecotoxicologie; C. ALMUNIA, CEA Paris-Saclay; D.D. Gouveia, Istrea Lyon / UR MALY Laboratoire Ecotoxicologie; J. Trapp, Istrea Lyon; J. Gaillard, CEA / Laboratoire de Biochimie des Systemes Perturbés; O. Pible, CEA; a. chaumot, O. Geffard, Istrea / UR MALY Laboratoire Ecotoxicologie; J. Armengaud, CEA / Laboratory Innovative technologies for Detection and Diagnostics. De novo mining of high throughput proteomics data in test species under contaminant exposure promises the possibility to gain insights into the mode of action of chemical compounds and molecular pathways involved in toxic responses. Intuitive network concepts (e.g. connectivity and modularity) have been found useful for analyzing complex interactions and successfully applied to study gene-gene and protein-protein interactions. Currently, a majority of protein networks are constructed using protein-protein interaction (PPi) databases. However, manually curated PPi databases are typically heterogeneous, documented for few model species, and often characterized by incomplete coverage, and selection or detection biases. De novo (or a priori) approaches based on observed data offer an alternative under which prior knowledge of protein interaction is not necessary but rather advantageously replaced by direct measurements and pair-wise correlation analysis of their abundance. This approach may be particularly powerful to identify signaling pathways which proteins with unknown function belong to or to identify novel, pertinent biomarkers of toxicant exposure. Here we present a network analysis method applied to shotgun high-throughput proteomic data we produced for the aquatic sentinel organism Gammarus fossarum. Shotgun proteomics was used to identify the molecular key players involved in different physiological states linked to reproduction and in case of exposure to pesticides potentially inducing endocrine disruption in this crustacean. We identified protein modules significantly associated to morphologically well-characterized physiological states and to pesticide exposure. Moreover, the identification of crucial hub proteins could allow proposing exposure-related or toxicological functional biomarkers. This new data mining procedure opens interesting perspectives for the development of a novel generation of molecular diagnostic biomarkers in ecotoxicology.

Towards a shared understanding of science and risk communication in the context of the inevitability of chemicals and the hazard they may represent (I)

478 How researchers can work in alliance with citizens to fight misinformation and improve public debates

S. Vanhoutte, Sense About Science EU.

Public resistance against glyphosate, GMOs, animal testing, vaccination and numerous other scientific innovations has made many scientists defensive and paranoid about the public. Recent discussion about a post-truth society and anti-intellectualism have increased this perception of a hostile and ignorant public. With concrete examples, Sofie will illustrate a different, more effective approach for both researchers and non-researchers to bring back reason into emotional debates. This approach, called public-engaged – i.e. which scientists respond directly to real, unedited questions from the public – breaks through polarised and difficult debates because conversation is led by the questions and issues people raise. It allows researchers to identify gaps and misunderstandings in the public debate and to respond to them. With this approach, rather than fighting the public resistance against new technologies, researchers can work in an alliance with citizens to fight misinformation and improve the public debate.

479 Discussion: the need to promote good science and evidence in public debates

480 How to communicate the risks posed by endocrine disrupting chemicals? (I)

J. Legler, Utrecht University / Institute for Environmental Studies.

There is emerging evidence that some of the increasing occurrences of endocrine-related disorders in humans and wildlife are linked to the exposure to endocrine disrupting chemicals (EDCs). Because of the potential of significant impacts on organisinal and population health that can result from disruption of endocrine homeostasis, numerous governments have established legislations that regulate chemicals that have the potential to interact with the endocrine system of humans and wildlife. However, while there is agreement on the need for regulation of EDCs, the frameworks and candidate EDCs differ significantly among regions. Furthermore, the mixed messages delivered by the media to the public with regard to the risks EDCs may pose add to the confusion currently existing within society, and which has split opinions on how to address this issue. This presentation will review the issue of endocrine disruption from a human health and environmental perspective, and discuss current approaches to the assessment of the risk/hazard of EDCs in Europe and North America. Through discussions among the presenters and the audience we aim to explore a roadmap on how to address the risks posed by EDCs and where the priorities for future research should lie.

481 How to communicate the risks posed by endocrine disrupting chemicals? (II)

M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre.

There is emerging evidence that some of the increasing occurrences of endocrine-related disorders in humans and wildlife are linked to the exposure to endocrine disrupting chemicals (EDCs). Because of the potential of significant impacts on organisinal and population health that can result from disruption of endocrine homeostasis, numerous governments have established legislations that regulate chemicals that have the potential to interact with the endocrine system of humans and wildlife. However, while there is agreement on the need for regulation of EDCs, the frameworks to assess and regulate candidate EDCs differ significantly among regions. Furthermore, the mixed messages delivered by the media to the public with regard to the risks EDCs may pose add to the confusion currently existing within society, and which has split opinions on how to address this issue. This presentation will review the issue of endocrine disruption from a human health and environmental perspective, and discuss current approaches to the assessment of the risk/hazard of EDCs in Europe and North America. Through discussions among the presenters and the audience we aim to explore a roadmap on how to address the risks posed by EDCs and where the priorities for future research should lie.

482 Discussion Endocrine Disrupting Chemicals

483 A regulator’s perspective in involving stakeholders and the public in the regulation of a substance

C. Ajan, ECHA-European Chemicals Agency; W. de Wolf, ECHA / Product Safety & Regulatory Compliance.

The European Chemicals Agency (ECHA) was established in June 2007 through
the REACH Regulation, and the registration of all substances already on the market above 1 ton per annum will be completed in 2018. Since its start the areas of responsibility expanded from industrial chemicals to biocides, capturing as well the communication of chemical hazards to workers and the public through the Classification, Labelling and Packaging Regulation (CLP), and the regulation of international trade of hazardous chemicals. The latter includes support for the protection of human health and the environment by providing developing countries with information on how to store, transport, use and dispose of hazardous chemicals safely through the Prior Informed Consent Regulation (PIC). Unl its decision making and opinion forming, ECHA uses the scientific information provided by academia and industry and applies them within the regulatory framework that it operates. Transparency is one of the values that is driving ECHA in its interactions with its different stakeholders, and the ECHA Scientific Committees invite ECHA’s accredited stakeholders as regular observers and contributors to its meetings. This presentation will look at regulatory science communication by describing the different stakeholders that ECHA interacts with, the forms of communication used and their timeframes. It will also explain the regulatory boundaries ECHA has to abide to, which influence the uptake of the latest science developments, and their communication with a special focus on the decision making and opinion forming at the Member State Committee. DISCLAIMER: ‘The views expressed in this abstract are solely those of the authors and the content of the paper does not represent the views or position of the European Chemicals Agency’.

484 Questions/Discussion

485 General Discussion with panel of Sofie Vanthournout, Juliette Legler and Markus Hecker

486 Concluding remarks part I and a teaser for part II
A. Leopold, Calidis Environment BV / Calidis Environment BV; T. Seiler, RWTH Aachen University / Ecosystem Analysis; C. Ajao, ECHA-European Chemicals Agency

Ecological risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (III)

487 The impact of chemical pollution on the resilience of soils under multiple stress
A. Kaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; W. Amelung, University of Bonn; H. Hollett, RWTH Aachen University / Institute for Environmental Research; M. Kaestner, Helmholtz Centre for Environmental Research UFZ / Dept Environmental Biotechnology; E. Kandeler, University of Hohenheim; J. Kruse, University of Bonn; A. Miltner, Helmholtz Centre for Environmental Research UFZ / Department of Environmental Biotechnology; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research; H. Pagel, University of Hohenheim; S. Peth, University of Kassel; C. Poll, University of Hohenheim; G. Rambold, University of Bayreuth; M. Schloter, Helmholtz Zentrum Munchen / Research Unit Environmental Genomics; S. Schulz, Helmholtz Zentrum Munchen; T. Streek, University of Hohenheim; M. Roß-Nickoll, RWTH Aachen University / Institute for Environmental Research

Soils are faced with man-made chemical stress, such as the input of organic or metal-containing pesticides, in combination with non-chemical stressors like soil compaction due to agricultural traffic and natural disturbance like drought. Although multiple stress factors are typically co-occurring in the environment, research in soil sciences on this aspect is limited and focuses mostly on single structural or functional endpoints. A mechanistic understanding of the reaction of soils to multiple stressors is currently lacking. Based on a review of resilience theory, we introduce a concept for research on the ability of soil polluted by xenobiotics or other chemicals as one stressor to resist further natural or anthropogenic stress and to retain its functions and structure. There is strong indication that pollution as a primary stressor will change the system reaction of soil, i.e., its resilience, stability and resistance. It can be expected that pollution affects the physiological adaption of organisms and the functional redundancy of the soil to further stress. We hypothesize that the recovery of organisms and chemical-physical properties after impact of a follow-up stressor in polluted soil differ from that in non-polluted soil, i.e., polluted soil has a different dynamical stability, and resilience of the contaminated soil is lower compared to that of not or less contaminated soil. Thus, a polluted soil might more easily change into another system regime after occurrence of further stress. We highlight this issue by compiling the literature exemplarily for the effects of Cu contamination and compaction on soil functions and structure. However, examples of further co-occurring stress scenarios will be described as well. In this discussion paper, we propose to intensify research on effects of combined stresses involving a multidisciplinary team of experts and provide suggestions for corresponding experiments. Our concept offers thus a framework for system level analysis of soils paving the way to enhance ecological theory.

488 Combined effects of temperature and metal exposure on cell membrane fatty acid composition, lipid peroxidation, antioxidant capacities and desaturase and elongase transcription in freshwater fish
M. Fadhlaoui, INRS / Centre Eau Terre Environnement; F. Pierron, Université de Bordeaux / UMR EPOC CNRS 5805; P. Couture, INRS / Centre Eau Terre Environnement

In this project, two freshwater fish commonly found in areas affected by metal contamination were acclimated to different temperatures (9 and 28°C for yellow perch (Perca flavescens) and 15, 25 and 30°C for fathead minnow (Pimephales promelas)) and exposed either to Cd or Ni during 8 weeks. At the end of exposures, we measured cell membrane phospholipid fatty acid composition, the activities of superoxide dismutase, catalase, glutathione-S-transferase, glutathione peroxidase (enzyme indicators of antioxidant capacities), the concentrations of glutathione (antioxidant) and malondialdehyde (indicator of lipid peroxidation (LPO)) as well as the transcription levels of desaturases (fasd2, desg2, scd2) and elongases (elov2, elov5, elov6). Both yellow perch and fathead minnow counteracted the effects of changes in acclimation temperature on cell membrane properties by remodelling their phospholipid fatty acid composition. Specifically, in the muscle of both species, polyunsaturated fatty acids increased in cold-acclimated fish compared to warm-acclimated fish, in agreement with the theory of homeoviscous adaptation. However, in brain cell membrane composition was more conservative, especially in fathead minnows. Polyunsaturated fatty acids are more vulnerable to LPO than saturated fatty acids and metal contamination leads to oxidative stress. We therefore tested the hypothesis that temperature-induced changes in cell membrane polyunsaturation are accompanied by variations in LPO in metal-exposed fish. Unexpectedly, in both species, metal exposure itself affected membrane fatty acid composition. In yellow perch, the normal response of cell membrane composition to thermal acclimation was reversed by exposure to both metals. Yet, in spite of the high polyunsaturation level in warm-acclimated fish under Ni exposure, MDa concentration was the lowest, suggesting a massive response of the antioxidant system to fight against LPO. In fathead minnow, metal exposure also affected the microarray of fatty acid composition of both tissues, but in opposite ways compared to yellow perch. We observed a mismatch between desaturase and elongase gene transcription and membrane composition. Overall, our results suggest that levels of control of cell membrane fatty acid composition other than gene transcription may be affected by temperature and metal exposure, such as post-transcriptional regulation of gene transcription and de novo phospholipid biosynthesis.

489 The effect of water chemistry on cadmium induced olfactory impairments in juvenile rainbow trout (Oncorhynchus mykiss)
S. Voitz, RWTH Aachen University / Department of Ecosystem Analysis; S. Bogart, A. Macdonald Wilson, University of Lethbridge / Department of Biological Sciences; H. Hollett, RWTH Aachen University / Institute for Environmental Research; G.G. Pyle, University of Lethbridge / Biological Sciences

Fish are dependent on olfaction since a variety of essential behaviours, such as foraging, predator avoidance and mate selection, are mediated by the olfactory system. Metals are well known to affect the olfactory system of fishes at environmentally-relevant concentrations. As metal toxicity varies with water chemistry, the exposure of fishes to metal pollution is a complex situation that requires a mechanistic approach. In order to assess the effect of Cd on the olfactory system, fish were exposed to 45-720 µg/L Cd for 24 h. Subsequently, olfactory responses to two odors were measured via electro-olfactography (EOG). To investigate the impact of water chemistry on cadmium induced olfactory impairments, fish were exposed to the EOG-based 24-h IC50 of Cd (210 µg/L) in reconstituted water with varying hardness, pH, and dissolved organic carbon (DOC) concentrations for 24 h. Cd inhibited the EOG response of rainbow trout in a concentration dependent manner. Fish exposed to 210 µg/L Cd for 24 h showed reduced olfactory response to TCA by 50%. Changes in water chemistry had a significant impact on Cd-induced olfactory impairment. Decreasing water hardness from 150 to 40 mg/L as CaCO3 increased the inhibitory effect of Cd on the EOG response from 55% to more than 95%, respectively. HARD, hardness ameliorated Cd-induced olfactory impairment. By contrast, Cd-induced olfactory inhibition increased with rising pH, which may be due to a difference in metal speciation. DOC had a protective effect against Cd-induced olfactory impairment, likely by forming complexes with Cd ions and reducing their
bioavailability. In conclusion, water chemistry is an important modulator of metal toxicity, not only for acute lethality but also for sub-lethal effects, such as olfactory impairment. In order to enable the prediction of site-specific olfactory toxicity, the development of a BLM parameterized to the olfactory system of fish would be very beneficial. However, more data on the effect of water chemistry on metal-induced olfactory impairment is required to be able to determine affinities constants and maximal binding capacities.

490 Physiological and biochemical responses of polychaetes: interplay of elements contaminated sediments and salinity changes

A. Pires, Universidade de Aveiro / Biologia; R. Freitas, University of Aveiro / Departamento de Biologia - CESAM; C. Patinha, Universidade de Aveiro, E.F. Silva, University of Aveiro / Geosciences; E. Figueira, University of Aveiro / Biology CESAM

Coastal systems often serve as sinks for toxic elements, and changes in salinity, predicted to occur due to global climate change are expected to influence elements geochemistry in aquatic systems. The effects of these changes can also alter biota sensitivity and distribution. A first step to understand this effect is to investigate how aquatic communities, mainly on those organisms living in sediments, such as polychaetes, which also support much of the diversity at higher trophic levels. So, this work examines the interactions of elements contamination and change in salinity and polychaetes performance, highlighting modifications that coastal systems may undergo due to alterations driven by salinity change. Polychaetes were exposed to elements contaminated sediments (median sand and fine sand sediments, collected from contaminated areas from ria de Aveiro lagoon, Portugal) and salinities 21, 28 and 40, for 28 days. This study aimed to evaluate physiological (regenerative capacity of Diopatra nepolitana), behavior (burrowing tests with Hediste diversicolor and Arenicola marina) and biochemical responses: indicators of cell damage (LPO: antioxidant (SOD and CAT), and biotransformation (GSTs) enzymes. After exposure, both types of sediments had lower total elements concentration (TEC), when compared to original sediments, mainly in sediments with A. marina and H. diversicolor. Sediments exposed to salinity 40, mainly those containing H. diversicolor had even less TEC than remaining sediments, which seems that salinity changes may influence elements availability. LPO levels were higher at salinity 40 for H. diversicolor and A. marina, and at salinities 21 and 40 for D. nepolitana. Although polychaetes were able to increase the activity of SOD, CAT and GSTs, these defense mechanisms were not sufficiently efficient to fight against the excess of ROS, leading to LPO. Furthermore, in H. diversicolor, the burrowing behaviour was impaired in polychaetes in fine sand sediments and salinity 40. For A. marina, exposure to median sand sediment for all salinities to fine sand sediment to a degree of 40% and at salinity 21 and 40 for D. nepolitana individuals exposed at salinities 21 and 40, for both sediments, exhibited lower capacity to regenerate their body when compared to salinity 28 (control). Overall, this study demonstrates that variations in salinity can strongly affect elements availability. Interaction of both variables impacted polychaetes responses differently.

491 Do trace metal contamination and parasitism infestation influence the activity of the bioturbator Upogebia pusilla?

A. da Ruir, EPOC, University of Bordeaux / UMR EPOC CNRS 5805; X. de Montaudouin, A. Clutat, P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; N. Bandimont, Université de Bordeaux / UMR EPOC CNRS 5805; O. Maire, P. Gourves, G. Daffe, A. LEGEAY, University of Bordeaux / UMR EPOC CNRS 5805

In marine environment, bioturbating species are considered as important ecosystem engineer species. Bioturbators are mainly benthic organisms living in the sediment. Their fossorial life style deeply alters the physical and biochemical properties of sediments. In marine soft-bottom environments, mud shrimp are considered as among the most important bioturbators. Because of their intense burrowing activities, they exert a major influence on solute and porewater exchanges, habitat structuration and benthic community composition. The influence of mud shrimp on their environment is related to the intensity of their behavior. Several factors could influence their distribution, such as salinity and temperature and thus modify the influence of these ecosystem engineer species. Regarding mud shrimp, only a few factors have been studied. Among them, the role of trace metals on mud shrimp fitness and bioturbation activities has never been investigated yet. Besides, mud shrimp are frequently parasitized by bopyrid isopods, known to have a deleterious effect on their host. Indeed, they deeply impair mud shrimp physiological state and potentially alter the bioturbation intensity. The aim of this study was to examine the role of a common trace metal (cadmium) and of bopyrid parasites on the physiology and the bioturbation activity of the mud shrimp Upogebia pusilla. We performed a 14-days ex-situ experiment evaluating the influence of Cd and/or parasite on the mud shrimp U. pusilla. Cadmium bioaccumulation and potential genetic responses to stress exposure were determined after 3, 7 and 14 days to trace metal exposition. The influence of both stressors on U. pusilla bioturbation activity was determined by evaluating sediment reworking rates of the mud shrimp after 3, 7 and 14 days to trace metal exposure.

492 Integrating ecotoxicology and ecology to advance understanding and prediction in multiple stressor research

R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences; J. Piggott, Trinity College Dublin / Zoology

Global environmental change is driven by multiple anthropogenic stressors. Conservation and restoration requires understanding the individual and joint action of stressors to evaluate and plan management measures. To date, most studies on multiple stressor effects have sought to identify potential stressor interactions, defined as deviations from null models, and related meta-analyses have focused on quantifying the relative proportion of stressor interactions across studies. These studies have provided valuable insights about the complexity of multiple stressor effects, but remain largely devoid of a theoretical framework for prediction of effects and null model selection. We suggest that multiple stressor research would benefit by 1) integrating additional null models from ecotoxicology and 2) selecting null models based on their mechanistic assumptions of the stressor mode of action and organism sensitivities as well as stressor-effect relationships. We present a range of null models and outline their underlying assumptions and application to a range of multiple stressor research The application requires multiple stressor research to shift its focus from identifying statistically significant interactions to the use and development of mechanistic (null) models. We discuss how ecotoxicological and ecological concepts will aid in achieving this.

Improving the Quality of Ecotoxicological Testing and Assessment

493 Updating the OECD Guidance Document 23 on aquatic toxicity testing of difficult substances and mixtures to include state-of-the-science approaches

W.S. Hunter, U.S. Food and Drug Administration/Centers for Veterinary Medicine; G. Stoddart, C. Fahlbender, PETA International Science Consortium Ltd.; M. Halder, European Commission Joint Research Centre / DG Joint Research Centre IHCP EURL ECVM; E. Salinas, BASF SE / Eperimental Toxicology and Ecology

The Organisation for Economic Cooperation and Development (OECD) Guidance Document (GD) on Aquatic Toxicity Testing of Difficult Substances and Mixtures (GD 23) was first published in 2000 and provides crucial guidance that supplements OECD Test Guidelines. Since its release much experience has been gained in handling difficult-to-test chemicals in aquatic exposures as well as progress made in developing methods for testing difficult test chemicals. The GD was revised as recently as 2016 to include state-of-the-science approaches. We provide an overview of the updated GD 23. One significant revision was the expansion of the guidance on testing of poorly soluble test chemicals. Attention was paid to updating exposure methods that do not employ a solvent in order to eliminate the need for a solvent control, and thus, reducing the number of animals used in aquatic toxicity tests. Another major revision was the addition of more detailed guidance for substances of unknown or variable composition, complex reaction products, and biological materials (UVCBs). The presentation also briefly describes other aspects of the updated GD of interest to those involved in aquatic toxicity testing. The updated GD 23 will help government agencies, industry, and contract research organisations conduct valid and reliable aquatic toxicity studies on difficult-to-test chemicals while minimising both the number of animals used and the need to repeat studies. The views, conclusions and recommendations presented in this presentation are those of the authors and do not necessarily represent the policies or positions of the United States Food and Drug Administration, the PETA International Science Consortium Ltd., the International Council on Animal Protection in OECD programmes, the European Commission or the OECD.

494 Calibrating Non-Target Arthropod (NTA) Lower Tier Assessment Factors F.M. Bakker, Eurofin-Mitos; S. Aldershof, Bioresearch and Evaluation; A. Dinter, Cheminova Deutschland GmbH & Co. KG / Global Regulatory Sciences; C. Elston, Syngenta Ltd; C. Mayer, BASF SE / Ecotoxicology; E. Pilling, Dow Agrosciences / Regulatory Sciences; G. Weyman, ADAMA; P. Neumann, Bayer AG

Assessment factors for Tier 1 and Tier 2 non target arthropods (NTA) were calibrated against NTA full fauna field studies for a large array of species, 20 active ingredients (23 products) and wide geographic coverage in the EU. It was investigated whether the current assessment endpoints at lower testing tiers are sufficiently protective and whether the array of test systems is sufficiently comprehensive. Lower tier studies, both Tier 1 and Tier 2, with several test species informative for calibrating limits for assessment factors based on different field risk tolerance criteria, for example in-field recovery periods varying from 1 to 12 months. Phytophagous taxa were analyzed separately, but as no differences in

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outcome with other taxa were observed, these were considered jointly. As expected Tier 1 studies had the most sensitive endpoint and consequently the largest HQ. Using the recovery endpoint, it was found that for the off-field HQ’s of 1, 6 and 250 delimited recovery ranges of 0 weeks (no effects), 4 weeks and 8 weeks, respectively in the off-field situation (hay meadow paradigm). For the in-field situation recovery intervals of 0-1, 1-2, 2-6, 6-12 and 12 months were delimited by HQ-values of 40, 375, 620 and 2500. Tier 2 studies could have lethal and/or sublethal endpoints. Using the most sensitive of the two and including a Vegetation Distribution Factor (VDF) of 5 the following HQ-values were derived for the off-field: HQ=1.7 for a no effect level. These HQ’s also correspond to 1 and 2 month recovery periods. For the in-field, using VDF=1, HQ’s are 1.3 for no effect and 6.6, 15, 60 and 560 for 1, 2, 6 and 12 months respectively.

495 The unforeseen consequences for animal welfare of the OECD TG 240 (MEOGRT) biological validity criteria

E. Salinas; BASF SE / Experimental Toxicology and Ecology; L. Weltje, BASF SE / Crop Protection Ecotoxicology

The Medaka Extended Oral Generation Reproduction Test (MEOGRT) was established in 2015 as OECD test guideline (TG) 240; a level 5 investigation under the OECD conceptual framework for endocrine disruption assessment. The MEOGRT brings together all aspects of the OECD chronic fish TGs 210, 234, and 229 into one test. OECD TGs include validity criteria as minimum standards for acceptable performance and particularly the biological control performance criteria are critical to assure relevant effects of a test chemical are detectable. Validity criteria assist regulators in determining study quality and reliability; studies that do not comply may be rejected and/or repeated. Compared to other fish TGs, the quantity of validity criteria in the MEOGRT TG have increased and are more stringent, thus elevating the potential for failure and repetition. Other investigators have already noted a high incidence of study repetition following well established OECD fish TGs. Hence, these data is a starting point for the evaluation of a new tool currently few laboratories can implement this highly complex TG. The MEOGRT arose from an international validation effort and recently the data from 9 validation studies were published. We compared control performance in those studies against the existing MEOGRT validity criteria to evaluate the compliance rate. Only 3 studies reported the control parameters corresponding to all biological control criteria and only 1 out of the 9 studies demonstrated successful compliance. The most prevalent deviation from the validity criteria was in the fecundity performance (4 out of 9 studies). Although some deviations from the validity criteria were minor, the failure to meet the fecundity criterion cannot be dismissed in a reproduction test where high fecundity is directly related to statistical power. The MEOGRT fecundity validity criterion is in principle achievable; however, given the available data, nearly 50% of all studies will need at least one repetition to meet this standard. The high likelihood of study repetition and consequent excessive vertebrate use must be considered when conducting a MEOGRT. The biology of the medaka has advantages, but also poses large hurdles to achieving reliable and valid test results. Therefore, alternative species and/or study designs should be considered to generate the data required to address protection goals, which also reduce the potential for excessive animal use.

496 Variability in Non-Target Terrestrial Plant Studies Should Inform Endpoint Selection

J.W. Green, BASF; J.W. Green, DuPont / Data Science and Informatics; J. Nusz, Exponent, Inc.; D.E. Edwards, BASF Corporation / Ecotoxicology; K. Henry, NovaSource / Tessendorf Kerley, Inc. / Ecological Sciences; M.E. Kern, Waterborne Environmental, Inc. / Ecotoxicology Risk Assessment; A. Deines, Exponent, R. Brain, Syngenta Crop Protection, Inc. / Department of Environmental Risk Characterization; B. Glenn, Bayer CropScience / graduate student; N. Ehresman, Nufarm; T.S. Kung, FMCP / Global Regulatory Sciences / Global Regulatory Sciences, Department of Biochemistry and Microbiology; F. Kee, FMCP / Corporation; K. Ralston-Hooper, Dow Agrosciences; S. McMaster, Industry Task Force II on 2,4-D Research Data

Inherent variability in Non-Target Terrestrial Plant (NTTP) guideline testing of pesticides creates challenges in principle achievable; however, given the available data, nearly 50% of all studies will need at least one repetition to meet this standard. The high likelihood of study repetition and consequent excessive vertebrate use must be considered when conducting a MEOGRT. The biology of the medaka has advantages, but also poses large hurdles to achieving reliable and valid test results. Therefore, alternative species and/or study designs should be considered to generate the data required to address protection goals, which also reduce the potential for excessive animal use.

497 An avian reproduction study historical control database: A tool for data interpretation

J. Wheelie, Dow Agrosciences; P. Valverde-Garcia, Dow Agro Sciences LLC; T.A. Spencer, EAG Laboratories / Specialist Projects & Histology; V.J. Kramer, Dow AgroSciences LLC / Ecotoxicology; M. Foudoulakis, Dow Agrosciences / RSRA ERS; I. Barber, Dow Agrosciences

Avian reproduction studies are a regulatory requirement for pesticides in many regions. The data often require careful interpretation due to the nature of the study design and where we present the results from two sets of mallard duck reproduction studies performed at the Evans Analytical Group LLC avian toxicology laboratory over the period 1985 - 2016. The analysis demonstrates the stability of reproductive parameters over time and good agreement to normal control ranges as required by the regulatory test guidelines. The major source of variation is shown to be within study variation. Recommendations for the use of historical control data for the interpretation of avian reproduction studies are made. We believe the analysis and evaluation presented here can facilitate the development of practical guidance that can be implemented in regulatory programmes requiring this test.

498 Experimental Design and Model Selection for Ecotox Risk Assessment

J.W. Green, DuPont / Data Science and Informatics

Recent experience with regulatory requests for re-analysis of older studies using newer statistical methodology has resurrected an old statistical issue of designing a study to fit its objectives and the dangers of imposing a statistical structure on data not fit for purpose. There is a continual need to update statistical methodology as new ideas arise data is aware to implement these methods become available. Problems can arise when new methods are imposed on old experimental designs. Imagine buying a plot of land with a small cottage. If we tear down the cottage, but leave the cellar and foundation, and then build a mansion in its place but based on the existing foundation, the resulting structure can be unstable and severely restricted in functionality. This presentation will explore the relationship between experimental design and the type of statistical model that can be fit to the resulting data and endpoints that can be estimated or determined from the model. In some instances, newer methods can be applied without problem to existing data. In other cases, existing data cannot support newer methods. It is important to understand the data requirements of the methods or models we intend to use. The size effect that can be estimated or detected is critically important and is strongly related to experimental design and biological variability. There is a model underlying every statistical test used to derive a NOEC or estimate an ECx. The basic statistical model for a simple toxicity experiment is given by $Y = \beta_1 + \epsilon$, where $\beta_1$ is the expected mean response in the i$^\text{th}$ concentration, and the $\epsilon$ are independent random errors, usually assumed to be identically distributed. What distinguishes one model from another are what distribution is assumed for the errors or responses and what restrictions or assumptions are placed on the treatment means, $\beta_i$. It is possible to determine the size effect that can be estimated or detected from a given dataset and it depends largely on experimental design and response variability. Statistical models used for hypothesis testing or regression estimates have data requirements. Model assessment tools are well established and should be used in fitting models to ecotoxicity data. Ignoring these tools or model requirements can lead to poorly estimated effects and misleading results. Understanding these concepts enables the scientist to make sound assessments of the data collected.

LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (II)

499 Integration of Risk Assessment and Life Cycle Assessment in the context of recycling wood waste into particleboard

S. Haywood, R.A. Alvarenga, J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology

Recycling of wood waste into particleboard has some environmental advantages, for instance, by giving second life to wood waste, (i) the use of fresh wood is avoided and (ii) it allows an extended carbon storage, which is beneficial in terms of climate change. However, wood waste sources have a varying chemical quality, therefore, recycling of post-consumer wood waste requires special attention to the determination of a representative and controllable wood waste feedstock. For example, may contain high concentrations of heavy metals such as arsenic and copper. Heavy metal toxicity is a threat to the environment and is associated with adverse health effects. In the particleboard industry, heavy metals may be discharged into the air when dust from wood waste is incinerated to supply heat for dryers. Moreover, downstream industrial customers of particleboard (e.g. furniture manufacturers), who incinerate wood-based dust from particleboards for internal heat supply, are of concern as well. Local human health effects due to reduced local air quality may question the overall benefit of recycling contaminated wood waste
into particleboard. A need exists to investigate the local human health risks associated with recycling contaminated wood waste, while simultaneously considering other impacts on human health and the environment throughout the entire life cycle traditionally modelled with Life Cycle Assessment (LCA). The objective of this study was the combined use of local Risk Assessment (RA) and LCA to achieve a broader assessment of the sustainability of recycling contaminated wood waste into particleboard. The current scenario, in which the use of contaminated wood waste in particleboard is limited by Flemish government’s standards, is compared to a future scenario with a higher use of more contaminated wood waste. As a consequence, in the future scenario, a lower proportion of the contaminated wood waste will be incinerated with electricity (and heat) recovery.

Modeling of the local air pollution is performed with the Immission Prognosis Air Concentration Tool (IMPACT) of the Flemish government. The LCA scope includes the particleboard industry, relevant upstream and downstream processes of the particleboard industry, and the incineration of wood waste. To integrate RA and LCA results on human health effects the concept of disability-adjusted life years (DALYs) is adequate as a common metric. Results will be presented at the conference.

500 Development of non-conventional LCA indicators for circular characteristics of bio-based products

K. Lokesh, University of York / Department of Chemistry; X. Bengoa, Quantis; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; A. Ernsstorfer, A. Ernsstorfer; F. Piccinno, EMPA Technology & Society Lab; P. Fantke, Technical University of Denmark / Biosustain; S. Sukumara, DTU Technical University of Denmark / DTU Biosustain; K. Lokesh, University of York / Department of Chemistry

This work is a part of the EU Horizon 2020-funded project, Sustainable Transition Assessment and Research of Bio-based products, the ultimate aim of which is to expand existing tools and methodologies for sustainability certification of bio-based products and for their speedy commercial uptake.

501 Toward a more sustainable biochemical industry - Early stage assessments and methodological overlaps between life cycle- and techno-economic assessments of biochemicals

A. Rasmussen, DTU (Technical University of Denmark) / Division for Quantitative Sustainability Assessment DTU Management Engineering and DTU Biosustain; S. Sukumara, DTU Technical University of Denmark / DTU Biosustain; P. Fantke, Technical University of Denmark / Quantitative Sustainability Assessment Division

Existing Life cycle assessment (LCA) studies of biochemicals reveal that there are challenges that need to be overcome in order to reach an overall high sustainability performance. While in some cases biochemicals have lower global warming impacts compared to fossil-based chemicals, other impacts may become higher, like eutrophication. One of the major sources of environmental impacts of biochemicals is the growing of biomass, which in most cases today is corn. This has led to investment in assessing opportunities of using side streams, like leftover agricultural lignocelluloses, or non-conventional biomass like algae. Macro-algae is one such potential source that they grow without being farmed, while simultaneously being an important sink for CO2. The objective of this study is to identify trade-offs between assessed environmental impacts and possible burden shifting between macro-algae compared to more conventional feedstocks like maize and lignocellulose. While it is imperative that any change in process configuration reflects in Techno-Economic Assessment (TEA) and LCA, there are very few studies which couples these two assessment demonstrating the trade-offs for improved decision support. The focus of this contribution is to explore methodological overlap between the two assessments and develop a framework, supported by a proof-of-concept. When contrasting current results from the TEA and LCA cradle-to-gate study, some interesting trends were observed. The TEA show that itds biggest hot spots are identified as feedstock cost which is a function of growing, transportation of biomass and if drying is taking place at the refinery site or closer to the harvesting sites of the feedstock. Whereas, the LCA shows the biggest environmental hot-spots occur in relations to growing of biomass. This requires external application of nutrients and knowledge of chemical pretreatment. Today developments for biochemicals are further developed companies mostly rely of results from TEAs. Our results show that the methodological overlap between TEA and LCA are of that magnitude that justifies the appraisal of this integrated methodology. Introducing LCA as a decision support tool would integrate sustainability requirements in development of technology and solutions. All technologies and products have a life cycle, and by analyzing their impacts, we put numbers on sustainability and benchmark the solutions.

502 A risk evaluation approach for indirect land use change associated to biobased products

D. Colonna, University of Bologna; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; V. Rossi, Quantis; J. Golazewski, UniwersytetWarnimskoMazurski W Olsztynie

Biobased products include a vast range of traditional and innovative materials and substances for purposes other than food and energy such as wood and composite materials, bio-plastics, adhesives, lubricants, paints and many other material categories feeding large economic activities. There is international recognition that developing a climate-smart bio-based economy is essential to the continuation of economic development, reduction of greenhouse gas emissions, and adaptation to climatic change. However, as biobased products are ultimately obtained from land or sea, a specific attention has to be payed when considering additional exploitation. Changes of land/sea use can rebound and cancel out environmental performances and added value to final products. This paper presents an extended and revised perspective that ILUC has been defined as an unintentional, negative, displacement effect of commodities in the primary sector such as agriculture causing additional land use changes. Provided that ILUC depends on specific legacy effects stemming from land condition prior and after land use changes, overall indirect effects are connected to the 1.1 billion tons of greenhouse gasses generated because of land use changes. However, the application of ILUC provisions as for biofuels has been and stays controversial. The Project STAR-ProBio is a multi-actor collaborative research and innovation action and supports the European Commission in the full implementation of European policy initiatives, including the Lead Market Initiative in bio-based products, the industrial policy and the European Bio-economy Strategy. One of the specific goals calls for identifying and mitigating the risks of negative ILUC effects associated to production routes for bio-based products. In this contribution the authors present the conceptual model and the results of the identification of risk factors obtained from the analysis of economic models and a sensitivity analysis performed over one selected case study.

503 How to find sustainable applications for new materials and how to overcome the relativity of LCA

C. Som, EMPA Technology & Society Lab; R. Hirschier, EMPA / Technology and Society Lab; F. Piccinno, EMPA

The Multi-Perspective Material Selection (MPAS) method has been developed as a decision support tool to design the most sustainable application fields for new materials that are still under development. This selection includes a 3-step method considering technical, economic as well as environmental criteria. So far, the method was best used for new materials that are replacing existing materials in a given application. But applying the MPAS in the case of a completely new kind of material or application field with no clear and existing competitor for comparison, the method revealed its limitations. Especially, the environmental assessment, that uses simplified LCA studies, is a relative approach. Another difficulty for the simplified LCA studies is when the production data of the material and, at the same time, the knowledge about the properties of the end-product are unknown and highly speculative. This is a common problem since the MPAS method is intended for early stage material design. Here, we present an expanded and further developed MPAS method that mitigates exactly these limitations meaning that the environmental assessment can be performed without a comparison case and also without the necessity of a lot of data. The development and expansions of the MPAS method is applied to each of its three steps. However, the main development of the method is made to Step 3, the environmental evaluation of the material. Our solution here uses a highly flexible set of criteria that are specifically adapted to the various cases and that are mainly LCA based. This means that the environmental score can now be obtained regardless of the ability to estimate the production data of the material and of the knowledge about the exact properties of the end-product. This evaluation can be applied absolutely or relatively/compareatively. Furthermore, the criteria are expanded with other criteria that go beyond only LCA relevant aspects and also include aspects like circular economy. The method is illustrated with a case study on nanoporous carbonaceous material. As a result, the most sustainable applications for this nanoporous carbonaceous material are identified and used to set parameters to be achieved for 108 SETAC Europe 28th Annual Meeting Abstract Book
the developers of the material. The new independent environmental assessment part in Step 3 overcomes the necessity of a comparison case while also reducing of the required amount of LCA data. This makes the method universally applicable.

504 Consumption and consumer footprint: LCA as pivotal methodology for assessing consumption patterns and ecoinnovations

S. Sala, A. Cerutti, European Commission Joint Research Centre / Bioeconomy unit; V. Castellani, EC-JRC; M. Secchi, European Commission Joint Research Centre / Bioeconomy unit

The European Commission has been developing an assessment framework to monitor the evolution of environmental impacts associated to the EU consumption. The assessment framework aims at supporting a wide area of policies, such as those related to bioeconomy, resource efficiency, ecoinnovation and circular economy. The assessment framework is composed of two sets of consumption-based indicators: the Consumption footprint and the Consumer footprint. The Consumption footprint assesses the potential environmental impact of apparent consumption, focusing on a territorial scale and accounting for trade, assigning the impact to the country where the final consumer is located. The Consumer footprint assesses the potential environmental impact of consumption, based on the results of life cycle assessment (LCA) of representative products purchased and used in one year by an EU citizen. The Consumer footprint allow assessing environmental impacts along the products life cycle (raw material extraction, production, use phase, re-use/recycling and disposal). For the calculation of the Consumer footprint, the consumption of European citizens is split into five key areas (food, housing, mobility, household goods and electric/electronic appliances). For each area, a respective Basket of representative Products (BoP) has been built based on statistics on consumption and stock of product. For each of the five BoPs, a baseline scenario is defined, taking as reference the consumption of an average EU citizen in the baseline year 2010. For the BoPs, the water quality in the area where the water body is located was improved since the fall of the Iron Curtain in 1989. Sediments, however, still carry the memory of an industrial past and are often “on the move”, transported by the current and flood events. Dating of sediment cores by Cs analyses facilitated lines of evidence based on bioaccumulation between organisms exposed to identical sediments in laboratory exposure. Although the chemical analyses used for bioavailability assessment have shown to be useful for predicting metal toxicity in sediments, the predictions food at the reference site can be quite poor, frequently owing to a broader range of factors influencing metal bioavailability including variability in phases that are easily oxidized or reduced (e.g. AVS and Fe(II)). In addition, laboratory-based bioassays may provide inadequate predictions of metal bioavailability and toxicity due to their inability to adequately replicate field exposure conditions. A comprehensive series of studies combining laboratory and field experiments were carried out to evaluate the performance of the diffusive gradients in thin films (DGT) technique for predicting metal bioavailability in sediments. The DGT device uses an ion-exchange resin (Chelex) which selectively accumulates divalent metal present in the sediment porewater and weakly-bound to the sediment particulate phase. The DGT metal flux measured at the sediment water interface (SWI) was compared to biological responses of organisms exposed to sediments contaminated with mixtures of metals, in the laboratory (amphipods and bivalves) and in the field (bivalves). To assist in the analysis of effects from the mixtures of the metals (Cd, Cu, Ni, Pb, Zn), DGT metal fluxes were normalised using water quality guideline values to account for predicted differences in the toxicity of the different metals. Strong dose-response relationships were found between normalised DGT flux measured at the SWI (DGT SWI) and adverse effects to reproduction and survival of the amphipod exposed to laboratory conditions. Use of predictive bioaccumulation were obtained for both marine and freshwater bivalves in laboratory and field set-ups. Differences in bioaccumulation between organisms exposed to identical sediments in laboratory and field set-ups highlighted the importance of including in sediment quality assessments lines of evidence based in situ evaluations of metal bioavailability.

506 Multiple lines of evidence for risk assessment of old sea deposits for ilmenite mine tailings in SW Norway

M. Schaanning, H. Trannum, K. Ntungu, S. Oxnevad, NIVA Norwegian Institute for Water Research

Anilime mine this deposit disposes up to 3 mill. tons of tailings contaminated with trace amounts of Ni and Cu sulfides. During 1960-94 the tailings were placed in two sea deposits, first in a sheltered fjord and then in a more exposed basin. After 1994 the tailings have been placed in a land-deposit. To protect the downstream watershed area, some of the metal contaminated drainage water is recycled, mixed with other discharge and fed into the water column at the site of the fjord deposit. In 2015 the deposit and reference sites were sampled for studies of macrobenthic communities, biogeochemical fluxes, metal mobilization and metal uptake in gastropods and DGT probes. O2 and pH in the sediments were measured using micro-electrodes. The tailings were easily traced in the sediments by high concentrations of fine fractions, Fe, Ni, Cu and Co. Tailings were still abundant in the top 0-1 cm of the sediments at both deposit sites, but clearly less abundant at the sediment surface than in deep deposit layers and also less in the outer basin deposit than in the fjord deposit. Compared to Norwegian and European quality standards [1], Cu exceeded MAC-EQS (“Maximum Admissible Concentration”) for coastal sediments indicating a “risk of acute toxic effect” on marine organisms. The DGT-profiles showed that Fe and Mn was recycled within the sediments, whereas Ni and Cu leaked to the overlying water from mobilization centers consistently located in the outermost sediments. The mine’s old sedimentation site was located within the fjord, but ecological status was classified as “good” at all sites and “very good” at the reference site. The sediment quality assessment lines of evidence highlight the importance of including in sediment quality guidelines, bioassays are usually performed to evaluate toxicity effects resulting from contaminant exposure. Although the chemical analyses used for bioavailability assessment have shown to be useful for predicting metal toxicity in sediments, the predictions food at the reference site can be quite poor, frequently owing to a broader range of factors influencing metal bioavailability including variability in phases that are easily oxidized or reduced (e.g. AVS and Fe(II)). In addition, laboratory-based bioassays may provide inadequate predictions of metal bioavailability and toxicity due to their inability to adequately replicate field exposure conditions. A comprehensive series of studies combining laboratory and field experiments were carried out to evaluate the performance of the diffusive gradients in thin films (DGT) technique for predicting metal bioavailability in sediments.

507 In situ metal fluxes for the assessment of metal bioavailability in sediments

F.D. Amato, University of Antwerp / Department of Biology; S.L. Simpson, Charles University / Institute of Applied Ecology; B. Doherty, University of Canberra / Institute of Applied Ecology; B. Doherty, University of Canberra / Institute of Applied Ecology; J. Taylor, University of Canberra / Ecochemistry Laboratory, Institute for Applied Ecology

Analysis of pore waters, dilute-acid extractable metal (AEM), acid volatile sulfide (AVS) and organic carbon (OC) concentrations are frequently used to evaluate and predict metal bioavailability in sediments. Where concentrations of bioavailable contaminants are determined to exceed sediment quality guideline levels, bioassays are usually performed to evaluate toxicity effects resulting from contaminant exposure. Although the chemical analyses used for bioavailability assessment have shown to be useful for predicting metal toxicity in sediments, the predictions food at the reference site can be quite poor, frequently owing to a broader range of factors influencing metal bioavailability including variability in phases that are easily oxidized or reduced (e.g. AVS and Fe(II)). In addition, laboratory-based bioassays may provide inadequate predictions of metal bioavailability and toxicity due to their inability to adequately replicate field exposure conditions. A comprehensive series of studies combining laboratory and field experiments were carried out to evaluate the performance of the diffusive gradients in thin films (DGT) technique for predicting metal bioavailability in sediments.

508 An Overview of the Refinements and Improvements to the USEPA’s Sediment Assessment Methodology


The USEPA’s Sediment Assessment Methodology (SedA) was developed in the 1990s as a decision support tool for evaluating the ecological condition of coastal and marine ecosystems. The SedA methodology is based on a probabilistic risk assessment framework and incorporates a tiered approach to risk assessment that allows for the incorporation of multiple lines of evidence. The methodology includes a series of sediment quality guidelines (SQGs) that are used to define the relative ecological status of a sediment sample. The SQGs are based on the results of bioassays and chemical analysis, and are used to determine the potential ecological effects of metals in sediments.

Recent refinements and improvements to the SedA methodology have been aimed at enhancing the accuracy and applicability of the SQGs, and improving the decision-making process for sediment risk assessment. These refinements include the development of new SQGs for emerging contaminants, the incorporation of biodegradation rates in the assessment of biologically available metals, and the use of more refined bioassay endpoints.

The overall goal of these refinements and improvements is to enhance the ability of the SedA methodology to support effective decision-making for the management of sediments in coastal and marine ecosystems. The refinements and improvements are ongoing, and the methodology will continue to evolve as new scientific advances are made and new data become available.
Toxicity Methods for Freshwater Sediment
T.J. Norberg-King, U.S. EPA / NHEERL/Mid-Continent Ecology Division; J. Hockett, U.S. EPA-Duluth, MN / ORD NHEERL Mid-Continent Ecology Division-Duluth, MN; C. Ingersoll, Retired; D.R. Mount, USEPA-Duluth, MN / ORD, NHEERL, Mid-Continent Ecology Division-Duluth, MN
Sediment toxicity tests are used for contaminated sediments, chemical registration, and water quality criteria evaluations and can be a core component of ecological risk assessment for contaminated sediment sites. Standard methods for conducting sediment toxicity tests have been established by USEPA, ASTM, Environment Canada and OECD. Revisions to USEPA’s Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates is planned for 2018. USEPA’s manual describes toxicity and bioaccumulation of sediment tests with 3 freshwater species, Hyalella azteca (amphipod), Chironomus dilutus (midge) and Lumbriculus variegatus (oligochoate) and 5 sediment toxicity test methods: 10-d tests with H. azteca and C. dilutus; a 42-d life-cycle test with H. azteca; a 50-d life-cycle test with C. dilutus and a 28-d bioaccumulation test with L. variegatus. While laboratories routinely tested acceptability criteria (TAC) for short-term sediment toxicity exposures (10-d control survival and ash-free dry weight), laboratories reported variable biological performance with the longer exposures. With input from both midge and amphipod workshops, each test method has updated guidance for the starting size/age of organisms, diets and rations, reconstituted water changes, modifications to test acceptability control survival, weight and other endpoints. Control waters need to have a minimum level of chloride and bromides at a sediment concentration of 0.5 mg/L. The test systems used were 1.5L glass vessels containing approximately 2 cm sediment and 1 L aerated spring water. Tests were performed to accept or reject individual tests, but serve as a broad indication of laboratory performance and possibly provide insight where refinements are needed. In this talk, we will focus on the testing methods and improvements that have been made in each method for USEPA and ASTM methods. This abstract does not necessarily reflect the views or the policies of the USEPA.

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Sediment-spiked toxicity tests with benthic macro-invertebrates and the fungicide fludioxonil
Lei Zhang, Alterra / Environmental Risk Assessment; J. Romão, University of Aveiro, X.H. Yin, Zhe Jiang Agriculture and Forestry University; T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team
In the EFSA scientific opinion on sediments, one of the oligochaete worms Lumbriculus spp. or Tubifex tubifex, supplemented with a second standard test species, Chironomus riparius, which belong to the group of aquatic insects, Chironomus riparius or the amphibid Hyalella azteca, are proposed as Tier-1 test organisms for fungicides with a biocidal mode-of-action. To investigate i) the potential difference between the use of field-collected and artificial sediments and ii) whether the proposed Tier-1 approach is protective, 28-d tests with fludioxonil-spiked field-collected and artificial sediment were performed with all sediment-dwelling invertebrate taxa. Overall tests, with field-collected sediment, showed better survival improvements for Chironomus riparius than with the amphibid Hyalella azteca. This indicates that the proposed Tier-1 approach is protective. There was no difference between field-collected and artificial sediments.

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Spatio-temporal exposure of Plant Protection Products in OECD 219 sediment test systems - Comparison of model results with measurements
K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; A. Dorn, Hochschule Niederrhein / Department of Chemistry; P. Daalkmann, Bayer AG Crop Science Division; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; D. Faber, Bayer AG, Crop Science Division / BCS D ETX Ecotoxicology
Sediment toxicity testing among other ecotoxicological tests is currently revised under the premise to improve quality and consistency of regulatory environmental risk assessments of plant protection products. In 2015, the European Food Safety Authority (EFSA) has published a scientific opinion on the development of new organisms where a water-spiked test system (OECD 219) is considered to study chronic effects on sediment organisms. Prominent test organisms are Chironomids, aquatic insects which live in and on soft sediments. Due to the design of this study initially large gradients between the exposure in the overlying water and in the sediment layer are established. As a consequence, substantial temporal and spatial dynamics of local concentrations have to be expected, especially in the vicinity of the interface between water and sediment where the Chironomids are supposed to stay. To describe local concentrations in such water-sediment test systems we simulated the transport and the redistribution of two moderately mobile (KOC 200 to 300) plant protection products with the mechanistic model TOXSWA. The results of the simulation are compared with measured sediment concentrations in three depths (see contribution submitted by Dorn et al.). The compound properties were parameterised using values derived independently in standard tests (KOC, DT50water/soil) or from literature (diffusion coefficients). Other parameters were derived from OECD 219 experimental design information. The simulations matched the measured concentrations spatially and temporally well. The simulated concentration depth profiles averaged for the layers which were measured lay almost always within the range of single measurements. Also the concentrations in the overlying water were reproduced well. The main findings are that the concentrations in the sediment show a pronounced temporal pattern and that the concentrations in the sediment are strongly depth-dependent. The dominant transport process in the sediment is obviously diffusion which however did not lead to homogeneous penetration of the sediment. Presuming that chironomids live in the upper three millimetres of the sediment, they are exposed to approximately four times higher test compound concentration (total and liquid) than the average concentration in the sediment. This has important consequences for the derivation of effect endpoints of chironomids from OECD 219 study data, which should consider the local exposure of the organisms.

Wastewater effluents: How research can improve risk assessment and regulation

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Effects of untreated wastewater dilution in surface waters on pharmaceuticals natural attenuation and on the community genomics: Implications for ERA
S. Bagnis, M. Fitzsimons, Plymouth University; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; A. Tappin, Plymouth University; S. Comber, Plymouth University / Environmental Science
The increasing consumption and production of active pharmaceutical ingredients (APIs) in low and low-middle income countries (LLMICs) is of growing environmental concern owing to their possible ecotoxicological effects. This is related to the practice of direct discharge of untreated wastewater (DUW), which creates a heavily polluted area, named the “impact zone”. Little is known about the environmental fate of APIs in this area. Nevertheless, a few available measured environmental concentrations (MECs) of LLMICs show higher concentrations than for high-income countries with developed wastewater treatment infrastructures. Globally, the MECs of APIs in the “impact zone” are typically above 0.01 µg L⁻¹, which, if predicted, would trigger the environmental fate refinement of the environmental risk assessment (ERA). In the ERA PEC calculation, a default dilution factor (DF) of 10 is used, but in at least 53 countries worldwide, the local predicted median DF is lower than 10. There is no information available in the literature about the effects of low dilutions on the natural attenuation of APIs nor impacts of DUW. Furthermore, information on the effects of low dilution on mixtures of APIs is missing, hence necessitating the requirement for evaluation of biological endpoints for the impact zone ERA. This information is pivotal for the development of an impact zone ERA approach, and we are proposing an original attempt to expand this approach within the framework of the H2020 project ecoCRISP, which is gathering a set of APIs was studied in batch tests at several levels of dilution. Neivaripro shows persistence across the experimental period and only the dilution is controlling the observed concentrations. Accutabol and Diclofenac show a decrease in concentration of up to 90% as a result of a combination of dilution and biodegradation. The biodegradation at no dilution shows a behavior consistent with previous reported studies. Overall, our results show that the sorption alone is responsible for the 70% of the removal. The TOC analyses do not show significant consumption rate changes caused by dilution. The results regarding the effects of the APIs mixture and the dilution on the microbial composition are been analysed by bioinformatic statistics, and will be presented if significant.

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Active Pharmaceutical Ingredients Entering the Aquatic Environment From
We conclude that the efficiency of removing pharmaceuticals in WWTPs is determined by the addition of ozone. Ozonation is a cost efficient way to degrade chemicals and is able to remove active pharmaceutical ingredients (APIs), the variations within and between sites, as well as the environmental impact of these are largely unknown. The aim of this study was to evaluate the removal of pharmaceuticals in a WWTP, when adding ozonation as an additional tertiary treatment step and also to investigate the environmental impact of this effluent on the receiving river. All treated effluent from a minor WWTP (10000 PE) were treated with an addition of 8 h² ozone during 6 months. Removal rates in the WWTP as well as levels of pharmaceuticals in the receiving river (both in water and biota) were monitored. Surface water data from 10 sampling sites and 10 sampling occasions, before and after ozonation, will be presented. Ecological status and levels of pharmaceuticals in exposed biota (n=5) at each site and sampling occasion will also be presented. Several additional methods to evaluate the impact of ozonation was used including impact on microbial community composition, presence of antibiotic resistance genes as well as studies to detect endocrine, reproductive and behavioral effects in fish and its progeny.

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**Dreissena polymorpha as purifier of protozoa in wastewater treatment plant effluent**

E. Kapp, University of Reims Champagne-Ardenne / UMRI SEBIO; D. Aubert, Laboratoire de Parasitologie-Mycologie / EA3800; S. Betoule, URCA / UMRI SEBIO; O. Dedourge-Geffard, University of Reims Champagne-Ardenne / UMRI SEBIO; D. RIOL'T, URCA 02 INERIS-URCA-ULH SEBIO / MOBYCTE flow cytometry core facility; L. Durand, S. La Carbona, ACTALIA; I. Villena, Laboratoire de Parasitologie-Mycologie / EA 3800; A. Geffard, Université de Reims Champagne-Ardenne; A. Bigot-Clivot, Université de Reims Champagne-Ardenne / UMRI SEBIO

Aquatic environments are subject to discharges of multiple contaminants (chemical and biological compounds). Wastewater treatment plants (WWTPs) are ineffective to remove environmental forms of protozoa such as Toxoplasma gondii and Cryptosporidium parvum oocysts or Giardia duodenalis cysts because of their resistance to treatment. These parasites have been identified as a public health priority since they are major parasites of waterborne outbreaks. Many studies underline the interest of using of fresh water bivalve Dreissena polymorpha for biomonitoring. Indeed, this bivalve has a huge filtration capacity leading to an accumulation of chemical and biological contaminant in its tissues. The DROPPE (The dreissen as purifier of protozoa in WWTP effluent) project aims to test the depurative capacity of the zebra mussel in terms of protozoa’s contamination in WWTP effluents. To answer this issue, it’s necessary to determine if D. polymorpha is able to live in good health in the multi-contaminated conditions in WWTPs effluent and D. polymorpha is able under these conditions, to bioaccumulate protozoa. For this purpose, two experiments were performed: 1 - Zebra mussels were caged in the WWTP’s outlet (city of Charleville-Mézières, France) for 28 days. We studied morphometric parameters, filtration capacity, energetic reserves, enzymes related to oxidative stress (Superoxide dismutase, Catalase, Gluthione S-Transferase and Gluthione Peroxidase) at biochemical and molecular levels. The results suggest that D. polymorpha can maintain itself in effluent for 21 days. 2 - D. polymorpha was exposed to different concentrations of protozoa (100, 1000 and 10000 protozoa per bivalve per day) for 21 days followed by 21 days of depuration in laboratory conditions. Detection of oocysts and cysts in tissues and haemolymph of bivalves was carried out by molecular biology techniques. The results highlight a time-dependent and dose-dependent bioaccumulation of protozoa by D. polymorpha. Moreover, the parasite load remains stable during the 21 days of depuration, suggesting that the bivalves could be used as a biological contamination Considering these results, Dreissena polymorpha seems to be a promising tool for protozoa depuration. Keys words: protozoa, wastewater treatment plant, bivalve, depuration

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**Aqueous macrophytes potential for the removal of water contaminants - The Green Liver Application**

S. Calado, Universidade Federal do Paraná / Ecologia e Conservação; M. Esterhuizen-Londt, Technical University of Berlin; H. Silva de Assis, UFPR / Pharmacology; S. Pfugmacher, University of Helsinki

Reservoirs are aquatic environments that are impacted by anthropogenic activities. The main activities around reservoirs in Brazil are agriculture and settlement. Agriculture and increase of nutrients can result in cyanobacterial blooms and cyanotoxins contamination; and settlements can results in inputs of several contaminants such as pharmaceuticals. Iraí Reservoir, located in South of Brazil, is...
used to water supply and has been reported as contaminated by cyanotoxins and pharmaceuticals. Therefore, this contamination increases costs to the water treatment and can cause toxic effects to the aquatic organisms and human health.

The aim of this study was to test Green Liver System to remove the contaminants, at the same concentrations that were found in the reservoir, using aquatic macrophytes. Egeria densa, Ceratophyllum demersum and Myriophyllum aquaticum were exposed to concentrations of diclofenac, microcystin-LR and microcystin-LR using a laboratory model of the Green Liver System for 14 days. Water samples were collected in 0, 1, 3, 7 and 14 days and plants samples were collected at the end of the experiment. Two control experiments were carried out in parallel. Water and plants samples were used to quantify the contaminants and plants samples were also used to evaluate the catalase and glutathione S-transferase activities. Plant species took up the contaminants and the removals of compounds were 93% for diclofenac and 100% for microcystin-LR. Our results showed that the plants antioxidant system was not activated and the Green Liver System was a suitable methodology to clean the water and to implement in phytoremediation programs. Keywords: Green Liver System, Reservoir, aquatic macrophytes, phytoremediation.

Antibiotics and Antibiotic Resistance in the Environment: Fate and Ecological Effects, Resistance Development and Implications for Human Health

517 Identifying hotspots of Antimicrobial Resistance Selection in the Natural Environment

J.B. Sallah, University of York / Environment; A. Boxall, University of York / Environment Department

Releases of antimicrobials into the environment increase selective pressures on environmental microbes contributing to the proliferation of antimicrobial resistance (AMR) and perhaps the inevitable ‘post antibiotic era’. One of many challenges in understanding environmental AMR is the high cost and organization required to provide widespread environmental monitoring. In lieu of this monitoring data, predicted environmental concentration (PEC) modelling based on pharmaceutical usage data has been demonstrated to be a useful tool in approximating antimicrobial exposures to the environment. Recently, attempts have been made to predict no-effect concentrations (PNEC) for selective pressures in the development of AMR. Coupling PEC and PNEC values provides a powerful tool to estimate the risks associated with a particular compound or class of compounds relating to AMR proliferation. Here we use this approach to identify hotspots where antibiotic exposure may be contributing to AMR selection for a range of different scenarios. Antibiotic usage data, data on metabolism, wastewater treatment and dilution data were used to determine PEC values, which were compared with reported PNECs to determine AMR hotspots for 56 compounds used in Wales as well as 9 chemical classes of antimicrobials in European Countries. Finally, using daily flow data, the approach was applied to a single wastewater treatment utility serving a population of approximately 18,600 persons with effluent discharge into the River Foss, UK to highlight the variation patterns in daily risk associated with AMR selection. Having illustrated the utility of the approach for a range of spatial and temporal scenarios, we believe that these results will be invaluable in informing future monitoring of antibiotics and AMR in the environment.

518 Urban and rural antibiotic resistance

M. Cook, R. Cooke, Newcastle University; C. Knepp, University of Strathclyde / Civil and Environmental Engineering; J. Su, Y. Zhu, Chinese Academy of Science; D.W. Graham, Newcastle University / School of Civil Engineering and Geosciences

Soils are both a source and a sink for antimicrobial resistance (AMR). Despite growing awareness of AMR in the soil resistome, debate continues over responsibility for increased AMR dissemination in this important environmental reservoir. While soil AMR is innate, the relative abundance of antibiotic resistance genes (ARGs) in soil has significantly increased over the last 60 years since the industrialisation of antibiotics. The reasons (e.g., antibiotic misuse, agriculture) for this rapid emergence continue to be debated. It is known that soil pollution is inherently linked to co-selection for ARGs yet limited information exists on large scale and multi-contaminated sites. This study was conducted on 24 locations across the North East of England to evaluate AMR in urban and rural soils with low and high pollution levels. We present pioneering high-capacity quantitative PCR profiles of 230+ antibiotic resistance genes (ARGs) and mobile genetic elements (MGEs). The project has coupled ARGs and MGEs to comprehensive geochemical datasets including 12 metals (total and bioavailable), 16 PAHs, and nutrient conditions to understand the evolution and dissemination of modern antibiotic resistance due to pollution.

519 Dissemination of extending-spectra β-lactamase E. coli carrying multidrug resistance and virulence factors in tropical rivers receiving hospital effluents

A. Luftig, University of Geneva / Institut Forel; V. Slavovsky, University of Geneva / Département F.-A. Forel des sciences de l'environnement et de leau; J. Poté, University of Geneva / Department F.A. Forel of environmental and aquatic sciences

The occurrence and dissemination of antibiotic resistant bacteria and their resistance genes from clinical settings to environmental compartment have become a major concern because of serious threat human health worldwide. Given the serious clinical threat of Extended-spectrum β-lactamases (ESBL) and carbapenem-resistant Enterobacteriaceae (CRE), studies are available in many countries from clinical settings. However, there is the dearth of studies in environmental compartments for the presence of these high threat gram-negative bacteria. This situation is particularly alarming in developing countries in which the freshwater resources receive urban and hospital effluent water without previous treatments. Additionally, the occurrence of the extended-spectrum β-lactamases (ESBL) and CRE in sub-Saharan African Countries are very limited. The aim of this research is to assess the role of untreated hospital and urban wastewaters on the biological contamination of urban rivers receiving systems in the city of Kinshasa, Republic Democratic of the Congo. 147 E. coli strains resistant to 3rd generation of β-lactams (ESBL) were isolated from water samples collected along 5 rivers receiving hospital effluents. They were analyzed for their clonality and the carriage of multidrug resistance and virulence genes. The results highlight a high level of clonality in strains (67 clones) and an important level of multidrug resistance regardless the sampling point. 53% of E. coli resistant to the 3rd generation of β-lactams were also resistant between 6 to 8 antibiotics. 14% of ESBL producers also carried virulence genes factors linked to E. coli pathotype determination. The generation of multi-drug resistant E. coli and not inappropriately linked to untreated hospital wastewater discharge in urban receiving systems and are widely distributed along the river, thus highlighting the risk of surface water use.

525 Methode for determining selective endpoints of antimicrobials

A. Murray, University of York; L. Zhang, I. Stanton, University of Exeter; J. Snape, AstraZeneca Global Environment / Medical School; W. Gaze, University of Exeter / Medical School

Antimicrobial resistance is one of the most significant threats to modern society. Use, misuse and overuse of antibiotics clinically and in the community; in agriculture and in hospital effluents is responsible for the selection of antibiotic resistant bacteria being released into the natural environment. Environmental concentrations of antibiotics are very low (ng/L range), but recent studies have shown that these concentrations may be sufficient to select for antimicrobial resistance. Currently, antibiotics are not risk assessed in terms selection for antimicrobial resistance in situ. This is largely because there is no standardised ecotoxicological assay which can predict selective endpoints. This work compares previously published methods for determining and predicting selective concentrations of antibiotics to two novel methods developed in this study. The first method tracks resistance gene prevalence over time in a complex community using qPCR, and the other is based on reduction in growth of a complex community. Results show that predicted no effect concentrations (PNECs) derived using standard ecotoxicological assays are not always protective against resistance selection. Currently, no agreed method for selective endpoint determination is always protective of the other; though there is good agreement between PNECs (PNECs for resistance) published previously and PNECs determined in this study. A novel method, based on growth of a complex community, is proposed for environmental risk assessment as it can be easily standardised, can rapidly generate selective endpoint data, and results show good agreement with more indepth data which tracks resistance gene prevalence over time. Results show that continued data generation and method optimisation is required to develop a reliable assay for determining PNECs for environmental risk assessment of antimicrobials.

521 Determining the minimal selective concentrations of macrolides in a complex microbial community

J. Stanton, University of Exeter / Medical School; A. Murray, University of York; L. Zhang, University of Exeter; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; W. Gaze, University of Exeter / Medical School

Antibiotic resistant bacteria and antibiotic resistance factors have been reported throughout the global environment. Continuous release of antibiotics from human activity can and does lead to measurable concentrations in surface waters (ng/L - µg/L), however these are lower than minimum inhibitory concentrations (MICs) and concentrations used in the clinic. Due to these relatively low concentrations, until recently it was thought that selection for resistant bacteria did not occur within the environment. Research published in 2011 and 2014 by Gubrist et al. showed selection at low environmental concentrations using single species assays. The macrolide antibiotic, azithromycin, clarithromycin and erythromycin, were added to the European Commission’s Water Framework Directive’s priority substances
watchlist in 2015 due to their measured environmental concentrations (MECs) and predicted environmental concentrations (PECs) being higher than their predicted no effect concentrations (PNECs). The aim of this study was to investigate the selective potential of these three compounds in a complex microbial community and to determine minimal selective concentrations (MSCs) for each. A number of week-long evolution experiments were conducted at a range of macrolide concentrations. QPCR determined the presence of a variety of macrolide resistance genes (ermF, ermB, mra, msd and mef) within the community. Change in prevalence of resistance genes, when in the presence of antibiotic, was compared to change in prevalence when no antibiotic was present. Out of all of the genes tested, the ermF gene shows a selective response at the lowest concentration for all three macrolide antibiotics. No significant selection is seen for ermB at 50µg/L but we do see significant selection at 75µg/L for all three compounds. The highest current MEC for any of these macrolide compounds is 4µg/L (erythromycin-H2O).

Data suggests, therefore, that current environmental concentrations of the macrolide compounds do not select for resistance genes in a complex microbial community.

522 Impact of multi-year exposure of agricultural soils to antibiotics on the soil resistome and mobilome.

C.H. Lau, Y. Tien, Agriculture and Agri-Food Canada; E. Topp, Agriculture and Agri-Food Canada (AAFC)

Antibiotics are entrained into agricultural soil through the application of animal manures and sewage sludge. In order to understand the potential long term effects of antibiotics on soil microorganisms, field plots were established in 1999 that have since received annual applications of a mixture of tylosin, chlorotetracycline and sulfamethazine, and a second series of plots was established in 2010 that receive a mixture of erythromycin, clariyromycin and azithromycin. Antibiotics have been applied every spring at concentrations ranging from 0.1 to 10 mg kg soil⁻¹ and plots have been continuously cropped to soybeans. A library of large cloned fragments was constructed using DNA sampled in 2014 from plots receiving the highest application rates, or no antibiotics. The library was cloned into antibiotic-sensitive Escherichia coli, and antibiotic resistance genes (ARGs) in the library were discovered by identifying E. coli clones that grew upon plating on solid growth media containing various antibiotics. Genes encoding resistance to many classes of antibiotics including the sulfonamides, tetracyclines, macrolides and β-lactams were identified, and sequence analysis revealed some to be entirely novel (Lau et al. 2017 Appl. Environ. Microbiol. 83 no. 16 e00989-17). A key question was whether the abundance of these genes increased in response to antibiotic exposure, evidence that would be consistent with functional importance in situ. The abundance of the novel targets as well as previously known ARGs, integrons and plasmids in soil DNA was quantified by real time PCR or with the WaferGen Biosystems high throughput qPCR instrument. Some gene targets (eg. intl, sul1, strA) were much more abundant in soils exposed to antibiotics whereas the vast majority of targets were not detectably increased in abundance. Overall, these results suggest that genes associated with integron cassettes are amplified in soil following repeated exposure to antibiotics.

Distribution, transformations and biological effects of incidental nanoparticles and nanoplastics in the environment from a more realistic point of view

523 Inter-annual monitoring of microplastics in marine intertidal sediments of the Firth of Forth

M. Hartl, Heriot-Watt University / Centre for Marine Biodiversity & Biotechnology, Institute of Life and Earth Sciences; Z. Lawrence, Heriot-Watt University / Institute of Life and Earth Sciences, Centre for Marine Biodiversity & Biotechnology; C. Holmes, A. Deery, Heriot Watt University / Centre for Marine Biodiversity & Biotechnology, Institute of Life and Earth Sciences; J. Blumennwidler, Heriot Watt University / Institute of Life and Earth Sciences, Centre for Marine Biodiversity & Biotechnology; P. Sechet, Heriot Watt University / Centre for Marine Biodiversity Biotechnology Institute of Life and Earth Sciences; R. Wood, Heriot Watt University / Institute of Life and Earth Sciences, Centre for Marine Biodiversity & Biotechnology; N. Mears, Heriot Watt University / Centre for Marine Biodiversity & Biotechnology, Institute of Life and Earth Sciences; J. Mccreton, Heriot Watt University / Institute of Life and Earth Sciences, Centre for Marine Biodiversity & Biotechnology

Microplastics (MPs) present in seawater of plastic smaller < 5mm are commonly found in the marine environment and originate either consumer care products and plastic production plants or from the disintegration of larger pieces. MPs need to be monitored in order to evaluate the effectiveness of Government initiatives to reduce plastic debris in the environment. The aim of the present study, therefore, was to contribute to the development of a hitherto lacking quantitative long-term marine MP database. We present the results of a three-year pilot project in the Firth of Forth, point to innovations in sampling and contamination prevention, as well as the limitations. Sediment samples were obtained in triplicate from intertidal sites in May 2014, May & Sept 2015, May & Sept 2016, 2017 using glass bijoux tubes as miniature cores and sealed with metal screw caps, processed using a density separation procedure and the polymer types determined using FT-IR spectroscopy. The results showed that there are high numbers of plastic particles (34-4,800 kg⁻¹) and fibres (1,700-4,300 kg⁻¹) along both shores of the Firth of Forth. The number of Fibres was generally higher than MPs. There was no apparent trend of spatial distribution. Although a spike in MP particles was observed from Sep 2015 and May 2016, there was no significant difference in MP particle concentrations between May 2014 and May 2017. There was also no significant difference in MP fibre concentrations during the same three-year period. There was also no evidence of seasonal fluctuations in MP concentrations. The results show that, for intertidal sediments in the Firth of Forth, the MP concentration has remained stable. This is significant baseline information and will be instrumental in assessing the effectiveness of Government policy regulating industry and consumer behaviour towards the production and use of particularly single-use plastic products. However, in order to compare results between countries and laboratories, for the purpose of gaining a more global insight into the microplastic contamination issue, more standardized sampling and extraction procedures need to be developed.

524 Do nanoparticles cause stress effects on microalgae? An infrared spectroscopy study.

M. Déniel, Institute of molecules and materials of Le Mans / Physique des Interfaces et des MesoStructures; N. Errien, Institute of molecules and materials of Le Mans; A. Caruso, laboratory Mer Molecule Santé; f. lagarde, Institute of molecules and materials of Le Mans / Institute of Materials and Molecules of Le Mans IMM UMR CNRS Nanoparticles are constantly used at world level leading to their presence in the aquatic environment leading to possible particles interaction with living organisms. The potential impacts of nanoparticle exposure on the biological activity of microorganisms is not well understood of the induced mechanisms. Microalgae are the base of aquatic trophic chain and different possible pathways of interaction between microalgae and nanoparticles are described in literature [1]. Moreover, infrared spectroscopy is known to monitoring material chemical composition. In this work, infrared spectroscopy is used to monitor the interaction between different types of nanoparticles and a model freshwater microalgae (Chlamydomonas reinhardtii). The aim is to understand the effect induced by nanoparticles and discriminate the responses of the microalgae in comparison with known stress mechanisms. Different stresses are realised in this goal: nutrient deficiency, light deficiency, metallic stress, gold and polystyrene nanoparticles. After 48h or 72h of interaction, the microalgae are collected and the infrared spectra (growth and genes expression) are analyzed by FTIR technique. The multi-variation analysis highlight that microalgae responses are stress dependent. Thus, infrared spectroscopy could be a new method to analyse stress effect on microalgae and particularly nanoparticles. Interaction with nanoparticles seems to induce an overall reduction of the main photosynthetic apparatus of microalgae. In conclusion, infrared and biological data relationships could explain interaction mechanisms between nanoparticles and microalgae. Keywords: nanoparticles, infrared microspectroscopy, effects monitoring [1] von Moos N & Slaveykova VI. 2014. Oxidative stress induced by inorganic nanoparticles in bacteria and aquatic microalgae–state of the art and knowledge gaps. Nanotoxicology. 8(6): 605-630.

525 Ecotoxicological evaluation of high-generation cationic PAMAM dendrimers towards a representative organism of aquatic ecosystems

G. Pulido-Reyes, M. Tamayo-Belda, M.G. Peiter, Universidad Autónoma de Madrid; L.m. betancor, F. Leganes, Universidad Autónoma de Madrid / Biology; R. Rosal, University of Alcala; F. Fernandez-Pitás, Universidad Autónoma de Madrid / Biology

Nowadays, nanomaterials are extensively used worldwide in many different fields and their potentially serious effects in aquatic ecosystems have become a global concern [1]. Poly(amideamine) (PAMAM) dendrimers are polymer nanomaterials, radially symmetric with an exponential increase in the number of terminal functional groups (growth and genes expression) are relieved to indicate if the induced stresses imply cytotoxic effects or molecular effects on the organism. The multivariate analysis highlight that microalgae responses are stress dependent. Thus, infrared spectroscopy could be a new method to analyse stress effect on microalgae and particularly nanoparticles. Interaction with nanoparticles seems to induce an overall reduction of the main photosynthetic apparatus of microalgae. In conclusion, infrared and biological data relationships could explain interaction mechanisms between nanoparticles and microalgae. Keywords: nanoparticles, infrared microspectroscopy, effects monitoring [1] von Moos N & Slaveykova VI. 2014. Oxidative stress induced by inorganic nanoparticles in bacteria and aquatic microalgae–state of the art and knowledge gaps. Nanotoxicology. 8(6): 605-630.
Hepatic mRNA expression levels of genes relevant for Cu uptake, storage and transport were characterized using Nano-technology. The results suggested that higher expression of these genes could contribute to the uptake and storage of Cu in the liver. A link between Cu exposure and oxidative stress was observed with the transcriptomic studies. Microarray analysis revealed several key genes that were differentially expressed, indicating altered metabolic pathways.

Trophic transfer of CuO NPs and aqueous Cu: from worms to fish

The production and discharge of nanoparticles has grown extensively over the last few years, raising concerns over their potential impact on environmental health, either alone or in combination with other anthropogenic contaminants. The study, funded by Natural Environment Research Council (NERC), aims to test the hypothesis that environmentally relevant carbon based nanoparticles (CNPs) and polycyclic aromatic hydrocarbons (PAHs) interact with each other to differentially modify their toxic potential. To probe this hypothesis, marine mussels were exposed for 3 days to benzo(a)pyrene (BaP) at concentrations above, below, and equal to the no observed effect level (NOEL). The results showed that the combination of CNPs and PAHs could significantly enhance the toxicity of BaP, affecting the uptake and genotoxic effects of BaP. Different responses were also observed with the transcriptomic studies. Microarray analysis identified several key biological processes (e.g., DNA metabolism, cytoskeleton, oxidative stress, and heat shock) that were altered due to the exposure of CNPs and PAHs. Further studies are needed to better understand the potential toxicity and environmental impact of these nanoparticles.

527 Transgenic fish of CuO NPs and Aqueous Cu: from worms to fish - a proof of concept study

Transgenic fish were used to study the potential toxicity of CuO nanoparticles. The results showed that CuO nanoparticles could affect the uptake and genotoxic effects of BaP, enhancing the toxicity of BaP. The genotoxic effects were characterized by the level of DNA strand breaks (comet assay), micronuclei and DNA adduct analyses. Global gene expression profiles were analysed using microarray technology to target specific stress pathways. Contrasting results were obtained, suggesting that the uptake of carbon nanoparticles used to expose mussels to MNWNTs and BaP seems to reduce the uptake and genotoxic effects of BaP in the digestive gland. Conversely, co-exposure to CNP and BaP does not seem to affect the uptake and genotoxic effects of BaP. Different responses were also observed with the transcriptomic studies. Microarray analysis identified several key biological processes (e.g., DNA metabolism, cytoskeleton, oxidative stress, and heat shock) that were altered due to the exposure of CNPs and PAHs. Further studies are needed to better understand the potential toxicity and environmental impact of these nanoparticles.

528 Corbicula fluminea exposure to copper oxide nanoparticles: an integrated mesocosm study

This study was supported by the Russian Science Foundation (project no. 16-10115). Corbicula fluminea were exposed to copper oxide nanoparticles (CuO ENP) at concentrations above, below, and equal to the no observed effect level (NOEL). The results showed that the combination of CNPs and PAHs could significantly enhance the toxicity of BaP, affecting the uptake and genotoxic effects of BaP. Different responses were also observed with the transcriptomic studies. Microarray analysis identified several key biological processes (e.g., DNA metabolism, cytoskeleton, oxidative stress, and heat shock) that were altered due to the exposure of CNPs and PAHs. Further studies are needed to better understand the potential toxicity and environmental impact of these nanoparticles.

Luminescent biomonitoring via bioassays of different complexity - from cells to whole organisms

Applications of Luminescent Bacteria Enzymes in Toxicology and Ecology

A new approach in developing bacterial luminescent enzymatic biosensors, application to toxicity bioassays, and the needed reagents has been developed. To solve the problem of how to detect, identify, and measure the numerous chemical compounds in environmental monitoring, food product contamination, and medical diagnostics, luminescent enzymatic toxicity assays were proposed, wherein the bacterial coupled enzyme system NAD(P)H:FMN-luminescent diagnostic enzymes were used for detection and identification of various compounds. The results of this study allow to conclude that CuO ENP affects C. fluminea at concentrations above 10 µM, suggesting an avoidance reaction. CuO ENP also induced significant impacts at the biochemical and molecular levels. However, the detected changes were low and did not show a clear and constant pattern. Further studies are needed to better understand whether detected effects may induce other effects at higher biological level (such as affecting behavior) or whether the avoidance behavior may have protected organisms from exposure, then lowering the effects that we were able to measure.

Toxic and adaptive effects via luminescent assay systems of different complexity - from cells to whole organisms

Applications of Luminescent Bacteria Enzymes in Toxicology and Ecology

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The possibilities of using fungal fluorophores to assess responses of filamentous fungi to external stimuli

E.V. Fedoseeva, Pirogov Russian National Research Medical University / Pediatric faculty; D. Khundzhuva, Lomonosov Moscow State University / Department of General Physics; V. Terekhova, Lomonosov Moscow State University / Lab of Ecotoxicological Soil Analysis; M. Freidkin, Lomonosov Moscow State University / Department of General Physics; S. Patsaeva, Lomonosov Moscow State University / Department of General Physics

The interest to functional and structural indicators of mycobacteria with a respective to use them in bioguidance is currently rising because fungi represent as essential component among environmental decomposers of organic material in ecosystems. The complexity of utilization of fungi in bioguidance is explained by diversity of reactions to external stimuli through their physiological and biochemical plasticity. In this regard, it seems very important to find the reactions of fungal cultures adequately reflecting their response to external stimuli in different conditions. The essential biogenic fluorophores such as NADH, tryptophan, melanin, ergosterol, pyridoxine, riboflavin, FAD, and FMN can be monitored instrumentally by spectroscopic techniques. The aim of the present study was to investigate the features of fluorescence spectra of fulamentous fungi cultivated under different concentrations of source of bioavailable and nor readily bioavailable carbon in the growth medium. The research objects were strains of Alternaria alternata, Chlamydomonas chlamydomonas, and Trichoderma harzianum. The strains were kindly provided by O.E. Marfenina and A.E. Ivaniva, Soil Science Faculty of MSU. The filamentous fungi and agar Cracep medium contained a varying level of sucrose (0.3% and 3%) and humic substances (0.02 and 0.1%). Fluorescence spectra were measured using a luminescence spectrometer Solar CM2203 at several wavelengths of the excitation radiation (250, 300, 310, 450, and 450 nm). Fluorescence excitation spectra were registered for emission at 350, 440, and 460 nm. Typical fluorescence spectra of fungal samples (spore suspensions of the NPs original and “engineered” UV-irradiation” constituted a two overlapping bands. The UV-band with maximum at 300-350 nm under excitation at 280 nm is a protein-like fluorescence, and the band in the blue region with the maximum at 400-450 nm under excitation at 310-370 nm is emission of fungal chromophores like NADH and or melanin. We suggest using the intensity of the first fluorescence band in the fungal samples for rapid evaluation of spore biomass. Measured fluorescence characteristics were found correlating with saturation of growth medium by source of bioavailable and not readily bioavailable carbon.

Therefore, we consider this research as promising on the way of using fungal fluorophores to assess responses of filamentous fungi to external stimuli.

Poster spotlight: WE209, WE210, WE211

Obesogens and lipid disruptors

Ecotoxicological Soil Analysis; M. Freidkin, Lomonosov Moscow State University / Department of General Physics; S. Patsaeva, Lomonosov Moscow State University / Department of General Physics

The interest to functional and structural indicators of mycobacteria with a respective to use them in bioguidance is currently rising because fungi represent as essential component among environmental decomposers of organic material in ecosystems. The complexity of utilization of fungi in bioguidance is explained by diversity of reactions to external stimuli through their physiological and biochemical plasticity. In this regard, it seems very important to find the reactions of fungal cultures adequately reflecting their response to external stimuli in different conditions. The essential biogenic fluorophores such as NADH, tryptophan, melanin, ergosterol, pyridoxine, riboflavin, FAD, and FMN can be monitored instrumentally by spectroscopic techniques. The aim of the present study was to investigate the features of fluorescence spectra of fulamentous fungi cultivated under different concentrations of source of bioavailable and nor readily bioavailable carbon in the growth medium. The research objects were strains of Alternaria alternata, Chlamydomonas chlamydomonas, and Trichoderma harzianum. The strains were kindly provided by O.E. Marfenina and A.E. Ivaniva, Soil Science Faculty of MSU. The filamentous fungi and agar Cracep medium contained a varying level of sucrose (0.3% and 3%) and humic substances (0.02 and 0.1%). Fluorescence spectra were measured using a luminescence spectrometer Solar CM2203 at several wavelengths of the excitation radiation (250, 300, 310, 450, and 450 nm). Fluorescence excitation spectra were registered for emission at 350, 440, and 460 nm. Typical fluorescence spectra of fungal samples (spore suspensions of the NPs original and “engineered” UV-irradiation” constituted a two overlapping bands. The UV-band with maximum at 300-350 nm under excitation at 280 nm is a protein-like fluorescence, and the band in the blue region with the maximum at 400-450 nm under excitation at 310-370 nm is emission of fungal chromophores like NADH and or melanin. We suggest using the intensity of the first fluorescence band in the fungal samples for rapid evaluation of spore biomass. Measured fluorescence characteristics were found correlating with saturation of growth medium by source of bioavailable and not readily bioavailable carbon.

Therefore, we consider this research as promising on the way of using fungal fluorophores to assess responses of filamentous fungi to external stimuli.
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The evolution of obesogen-induced phenotypes in vertebrates
A. Capitão, M. Lopes-Marques, R. Ruivo, E. Fonseca, R. Jorge, M. Barbosa, C. Porte, IDAEA-CSIC - Department of Environmental Chemistry; M. Blanco, IDAEA-CSIC; A. Maceda-Veiga, University of Barcelona / Department of Animal Biology

New developments of analytical techniques have allowed the effective identification and characterization of lipids and the development of lipidomics, which has recently emerged as a key technology for human disease research and discovery of biomarkers. However, on an environmental toxicology context, studies are still few, in spite of lipids being considered key molecules for the bioaccumulation of chemicals. This work applies ultra-high performance liquid chromatography coupled to high resolution mass spectrometry (UPLC-HRMS) to characterize the lipidome of the tissues of two fish species (Barbus meridionalis, Squalius laietanus) collected along the Ripoll River. Sampling sites included upstream (reference) and downstream (urban and industrial discharges) areas. A total of 130 lipid species, including phosphatidylcholines (PC), PC-plasmalogens (PC-P), cholesterol esters (CE), triacylglycerols (TG), diacylglycerols (DG) and sphingomyelins (SM) were detected in the muscle tissue. Partial least squares discriminant analysis (PLS-DA) allowed a clear separation of the lipidome of fish from polluted and reference sites. Specifically, a relative increase of CEs (18:1, 20:4, 22:5, 22:6) and some PC-Ps (32:0, 36:4, 36:5, 38:6) was detected in the muscle of B. meridionalis sampled in polluted sites. In contrast, the lipidome of S. laietanus from polluted areas was characterized by a significant increase of TGs and PC-Ps and a concomitant decrease of PCs with a high number of double bonds (36:5, 36:6, 38:6, 40:6, 40:7). The results suggest potential lipid oxidation of highly unsaturated PCs, particularly in S. laietanus living in polluted sites together with a concomitant increase in neutral lipids (TGs, CEs), possibly due to an increase in the energy demand to respond to stress in polluted sites.

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Lipidomics profiles distinguish fish from organochlorine pesticide contaminated lakes compared to controls
N.D. Denslow, M. Nouri, University of Florida / Physiological Sciences; K.J. Kroll, University of Florida / Physiological Science; C.I. Martyniuk, University of Florida / Physiological Sciences; V. Dang, Iowa State University

Organochlorine pesticide (OCP) contamination of Lake Apopka largely derived from high application use in the muck farms on the North Shore. These practices were discontinued in the 1970’s but fish in Lake Apopka continue to have relatively high body burdens of organochlorine contaminants. Previous transcriptomics experiments have indicated that the OCPs alter endocrine related endpoints in ovary and liver of exposed fish. In addition, changes in lipid transport and metabolic pathways are affected. Current work explores changes in the lipidome of largemouth bass caught in Lake Apopka compared to fish from a relatively clean lake in the Ocala National Forest. We used both a shotgun approach and a targeted approach to quantify perturbations in phospholipids in liver of largemouth bass from Lake Apopka compared to a relatively clean lake. Follow up experiments with fish exposed in the laboratory support the changes seen in the field. Cholesterol esters (CE) were increased and cholesterol esters were elevated in the livers of fish from Lake Apopka compared to Wild Cat Lake. This finding corroborates reduced hormone biosynthesis in organochlorine contaminated fish. Other changes in the lipidome are consistent with predicted changes that are related to immune dysfunction. Enrichment in Lake Apopka fish was observed in short chain length free fatty acids, such as palmitic acid and in ceramides, phosphatidic acids and phosphatidylethanolamines. These changes are consistent with lipids that are changed due to inflammation and other immune responses. We postulate changes in the lipidome are important biomarkers of OCR contamination.

Poster spotlight: WE027, WE028, WE029

Towards a shared understanding of science and risk communication in the context of the inevitability of chemicals and the hazard they may represent (I)

541
Nanotechnology: When shading effects through agglomeration of carbon nanotubes (CNT’s) are confused with toxicity by media and the public - a case example revisited
R. Schwab, Adolfo Merkle Institute / Materials Science

Engineered nanomaterials are relatively new contaminants with that can enter the environment via an increasing variety and number of waste streams. The long-term toxicity of nanomaterials is not well understood, and these materials are therefore of emerging public concern. In 2011, we published a press release about our scientific publication on the effects of carbon nanotubes on green algae [1]. We found that the nanoparticles under investigation did not directly affect the algal viability, but indirectly reduced the algal growth via shading and agglomeration. To our surprise,
this press release led to a cascade of secondary articles and events. On the one hand, some online newspapers used our article to produce alarming articles about the dangers of nanoparticles for the environment (example translated from German: “Nanoparticles Identified as Potential Environmental Killers” [2]). On the other hand, some individuals used the press release to draw the oversimplified conclusion that all engineered nanomaterials will eventually agglomerate and therefore be harmless. Nevertheless, most of the media took over the message with no or minor modifications. The press release also triggered surprising responses from within the research institutions. In this presentation, I was invited to briefly summarize the different responses that we got to this press release, and re-iterate the short- and long-term lessons learned from this case study. Most importantly, the ‘real’ work for a scientist writing a press release starts after its publication. News on topics of public concern such as the toxicity of engineered nanomaterials are very closely watched and instrumentalized both by the pro- and the anti-nano community for their respective intentions. Reactions on press releases concerning these topics have to be monitored closely, wrong quotations must be corrected and biased interpretations must be adjusted, in order to provide correct scientific information for the common public. The reward for this work is an overall more balanced communication of the results. [1] Schwab, F, Bucheli TD, Luhkehe LP, Magrez A, Nowack B, Sigg L, Knauer K. 2011. Are carbon nanotube effects on green algae caused by shading and agglomeration? Environ Sci Technol 45:6136-6144. [3] Georgescu V. 2011. Nanopartikel als potenzielle Umweltkiller ausgemacht. www.lifegene.de/newspage/shownews.php?4+getnews=nm2011-11-09-3109+pc=02. Accessed 22 Nov 2017 Acknowledgements and Disclaimer - Schwab, F was supported by an Ambizione fellowship of the Swiss National Science Foundation (grant number 168187). Any opinions, findings, conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the Adolphe Merkle Institute or the SNSF. This work has not been subjected to their review and no official endorsement should be inferred. The author reports no other conflicts of interest and is responsible for the content of the abstract and presentation.

542 Nanotechnology: Communicating scientific findings through media – what could possibly go wrong? Lessons learned from Schwab’s nanotubes

G. Obereg, UBC / IRES; A. Seal, University of British Columbia / School of Journalism

There is no single effective method for scientists to communicate their findings with the media. Unfortunately, Dr. Fabienne Schwab found this out after publishing a press release about the effects carbon nanotubes (CNTs) have on green algae. When the story hit the press, mainly through an article in Der Spiegel, many readers found the story implausible. As a result, Dr. Schwab and her colleagues were accused of fear-mongering. Things escalated to the point that Der Spiegel had to shut down the article’s comments section. Where did things go wrong? How can scientists make sure the media presents their work accurately, but also in a way the general public can understand? We will discuss the diverging roles and realities of science and media, particularly the considerations that scientists and editors need to take into account when they decide to write/publish something.

543 Discussion Nanotechnology

544 Microplastics: The risks of plastics – perceived or real?

M. Kottermann, IMARES / Fish

Plastic has not only become a major research topic, it is also broadly covered in popular news. As result the general public knows about the plastic soup and how dangerous it is, supposedly, for wildlife and ultimately for human health. However, the history of plastic research is peculiar. Some of it was straightforward; wildlife choking in plastic does not need much additional proof or QC QA. But, as with many new research topics, the first articles about the dangers of plastic were soon followed by others. The focus was on the presence of small plastics particles even in raw seafood, honey and even in drinking water in some remote areas. It soon became apparent that many of the plastic fibres observed in the samples were a result of cross contamination by air. Secondly, while plastic particles do not behave very differently from other particulate matter with respect to absorption of organic contaminants, all known equilibrium processes of contaminants between particulate material, biota and water were blatantly ignored. Contaminants in open seas would first sorb strongly to plastics, to desorb readily in the gastrointestinal tract of fish, leading to higher bioaccumulation of pollutants like PCBs in the food chain. The fact that the amount of ingested plastic is still almost negligible compared to the natural food intake makes these claims even more difficult to uphold. Therefore, it was disappointing that even Science published an article about the dangers of plastic microparticles for fish larvae, while the manuscript did not comply to the journals own quality standards. And as it seems now, the described research has not even been performed. So, besides the obvious and clear detrimental effects of plastic debris in the environment, an important concern of plastic may be that research on the environmental impact of plastics is not always conducted following proper scientific guidelines. In this presentation I will also discuss shortly the more recent progress in plastic research, such as the exposure of humans to plastic particles.

545 Lost in translation: Do we communicate the risks of (micro)plastics in the right way?

M. Waagner, Norwegian University of Science and Technology / Department of Biology

While research on the environmental and health risks of microplastics is still in its infancy, the public has already concluded there are unacceptable risks and, consequently, demands for action. This puts environmental toxicologists and chemists in an uncommon position, namely that public awareness of a potential environmental issue is way ahead of an evidence-based assessment of the actual risks. To further complicate the matter, researchers face a fundamental dilemma: Current narratives on the negative implications of (micro)plastic pollution create public awareness and promote change towards more sustainable economic practices, e.g., with regard to circular economy. However, these narratives are in many cases not backed by scientific evidence. The question is now: How can we promote positive societal change and at the same time stay true to the scientific principles? In my talks, I will not present final answers to this question but rather provide a diagnosis of the recent microplastics debate. I will argue that plastic pollution represents a challenge to our disciplines with regard to the following fundamental aspects: 1) absence of a common risk understanding, 2) bias when dealing with information-scarce situations, 3) lack of mechanisms to prioritize environmental issues, 4) lack of mechanisms for consensus-building regarding the risk of environmental stressors. I will further argue that the field of plastics pollution represents an ideal playing ground to explore, discuss and advance these aspects. This will be crucial to get our disciplines fit to deal with the wicked problems, we face in the Anthropocene.

546 Ocean Literacy – changing attitudes and behaviour of society in the face of the problems of the oceans

A. Borja, Anti-Tecnalia / Marine and Coastal Environmental Management

The H2020 project ResponSEable (www.responseable.eu) is trying to raise awareness around six key-stories (fishing, eutrophication, renewable energies, coastal tourism, microplastics, and ballast waters), within the four European regional seas. Under the DAPSIWRM framework (Drivers, Activities, Pressures, State, Impact, Wellbeing, Responses, Measures) we are developing products to change attitudes and behaviour of different actors related to each story, but also to the society at large, from children to adults, trying to test the changes in those attitudes. The products include videos, cartoons, serious games, interactive tools, specialized courses, etc. Our aim is that if scientists and society have a shared understanding of science and risk communication regarding the problems of the oceans, these can be solved through the individual and collective changes in our attitudes towards the oceans in our daily lives.

547 Discussion Microplastics

548 General discussion with panel of all speakers about topics emerging from the session

549 Wrap-up and closing

A. Leopold, Calidris Environment BV / Calidris Environment BV; T. Seiler, RWTH Aachen University / Ecosystem Analysis; C. Ajoa, ECHA-European Chemicals Agency

Hazard and exposure assessment of chemical mixtures: steps towards increasing the realism of chemical risk assessment (I)

550 Development of a diagnostic toolbox for ecological effects of pollutant mixtures and application to evaluate results from the third Joint Danube survey

A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; T. Seiler, RWTH Aachen University / Ecosystem Analysis; J. van den Brink, Alterra Wageningen UR / Aquatic Ecology and Water Quality Management Group b Alterra; B. Deutschmann, RWTH Aachen University
A common framework for the assessment of human and ecological risks from pollutant mixtures in European surface waters - case study with >300 chemicals co-occurring in the Danube
A. Kortenkamp, Brunel University London; M. Faust, Faust & Backhaus Environmental Consulting; S. Ermler, Brunel University London / Institute of Environment, Health, and Societies; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health

Mixtures relevant for human health or the environment can easily contain dozens or even hundreds of chemicals. However, those components do not contribute equally to the overall toxicity. For instance, there is no known chemical that often only a very few chemicals dominate the mixture risk. The European Commission has therefore emphasized in its communication the need to “identify chemical substances that are the main drivers of mixture toxicity”. This could tremendously help to steer future chemical monitoring efforts and risk mitigation measures.

However, it is currently unclear how a common definition of the term “driver of mixture toxicity” can be operationalized. In the presentation, we will provide the results of existing approaches to define “mixture risk drivers” and explore the consequences of their application to a real-world dataset (Swedish pesticide monitoring data). In particular, we will demonstrate that the use of Concentration Addition, which is common in all approaches, might not always be justifiable for the ranking of mixture components. Additional we will discuss: (i) the sensitivity of the various methods to data gaps, (ii) the challenge of tiering the various approaches for risk driver identification, and (iii) the question whether a risk-based ranking is the optimum approach, or whether hazard- or exposure-based methods can be suitable alternatives. In summary, we conclude that, although the identification of drivers of mixture risk would constitute a major step forward to systematize and simplify the seemingly overwhelming complexity of chemical exposures encountered during human health and environmental risk assessments, the concept is currently not yet fit for purpose. Important steps remain to be taken, in order to better conceptualize and operationalize the concept. However, more and more empirical data become available from monitoring studies that provide ample material to explore the applicability of the concept and its consequences for risk management.
assumptions about modes of action are introduced. We tested the utility of the scheme by using data on the levels of more than 300 chemicals that occur together in the river Danube, from the Joint Danube Survey 3 (JDS3). For each of the 54 sites along the river Danube we ranked the chemicals in terms of their contribution to a mixture effect, separately for algae, daphnia and fish. We found that the overall mixture toxicity was driven by only approximately 10 chemicals. Substances not yet defined as priority substances under the EU Water Framework Directive made a substantial contribution to combined exposures. We also assessed the potential combined risks to humans by evaluating whether water drawn from the Danube would be fit for human consumption. Overall, exposures of concern for humans could not be detected at higher tiers of the assessment. We conclude that the protection goals defined in the Water Framework Directive for freshwater aquatic communities are not achieved for combined exposures at many sites along the Danube.

555 Pesticides do rarely come alone, except in risk assessment - Risk indices of ranked spray series of the project COMBITOX

B. Scholz-Stanke, RWTH Aachen University / Institute for Environmental Research / Institute for Environmental Research; S. Bär, German Federal Environment Agency UBA / Section Plant Protection Products; B. Daniels, RWTH Aachen University / Institute for Environmental Research; T. Frische, Federal Environment Agency UBA / Section Plant Protection Products; M. Liess, UFZ Center for Environmental Research / System-Ecotoxicology; R. Ottermanns, M. Roli-Nickoll, RWTH Aachen University / Institute for Environmental Research; A. Schäffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; A. Sybertz, RWTH Aachen University / Institute for Environmental Research; C. Ullrich, German Federal Environment Agency UBA / Section Plant Protection Products; S. Knüllmann, Helmholtz Centre for Environmental Research UFZ / System-Ecotoxicology

In the European Union, legislation so far strictly regulates plant protection by means of chemical pesticides on the level of single products. Common agricultural practice and manifold pest pressures lead to the exposure of non-target organisms to complex mixtures in a spray series. In the on-going COMBITOX project, we collated a dataset for the actual application patterns of pesticides in 12 representative crops in terms of acaricide and pesticide application rates from the years between 2007 and 2015. The data was used for classification of sprayseries by typical mixture patterns, sequences and toxic pressures. Combining all information on empirical use patterns and their regional and temporal variation, we calculated indicators of use intensity and environmental risk. Toxicity exposure ratios (TER) were calculated using standard toxicity data (aquatic & soil organisms) from two publicly available databases PPDB (Lewis et al. 2016) and ECOTOX (US EPA 2017) and the mere application rates without consideration of exposure pathways. Only for focal sprayseries, first and higher-tier risk indices (including mandatory risk management measures) for different compartments were computed according to the standard approach as conducted by the UBA within the PPP-authorization procedure in Germany. In sum, 29 risk indices were computed (TER-values). Normal risk indices were calculated based on the concentration addition from single-substance TER and summed up per application date. In general, patterns of pesticide use showed that tank mixtures and spray sequences are predominantly in all crops that were considered in our studies. From the data, we revealed that crops group together in classes of use patterns. The cereals received a wide range of different pesticides classes in medium intensities during the whole spraying sequence; vine and apple orchards were dominated by cereal received a wide range of different pesticides classes in medium intensities during the whole spraying sequence; vine and apple orchards were dominated by cereal

557 Toxicity of imidacloprid and thiadloprid towards four Collembolan species C. Lima, Vrije Universiteit Amsterdam / Animal Ecology; C. van Haren, G. Mainardi, Vrije Universiteit Amsterdam / Department of Ecological Science; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science

Folsomia candida has been used for assessing the toxicity towards non-target soil invertebrates since the 1960s, but only in the 1990s a standard reproduction test was introduced. In 2000, after a ring test, OECD also accepted Folsomia fimetaria as a model organism. The first species, has been transported all over the world, therefore being considered a tramp species, having a parthenogenetic mode of reproduction. F. fimetaria is present in most of natural and agricultural soils worldwide, and has a sexual mode of reproduction. Following a suggestion of the ring test to use different species or standard traits to assess the toxicity of contaminants, in this study two additional species, Heteromurus nitidus and Sineilla curviseta, were used together with F. candida and F. fimetaria to determine the toxicity of imidacloprid and thiadloprid in Lufa 2.2 soil. The tests aimed at answering two main questions: (i) Is there a difference in the sensitivity to neonicotinoids between the different species? (ii) Are these species suitable for assessing the toxicity of neonicotinoids? Imidacloprid was most toxic. F. fimetaria presented around the same sensitivity as F. candida for survival (LC50 0.56 mg kg dry Lufa 2.2 soil), and a slight difference in the sensitivity for reproduction, with EC50 for F. fimetaria 0.10 mg kg dry soil and for F. candida 0.26 mg kg dry soil. H. nitidus was slightly less sensitive with an LC50 of 1.6 mg kg dry soil and an EC50 of 0.40 mg kg dry soil. Thiadloprid was tested on S. curviseta, F. candida and H. nitidus, with survival of the first one being least sensitive (LC50 27 mg kg dry soil), followed by F. candida (LC50 5.2 mg kg dry soil) and H. nitidus being the most sensitive with an LC50 of 2.3 mg kg dry soil. Thiadloprid was more toxic than the reproduction of S. curviseta (EC50 2.6 mg kg dry soil) followed by F. candida (EC50 1.5 mg kg dry soil), and H. nitidus (EC50 1.3 mg kg dry soil). The different species tested presented similar sensitivities in terms of survival for thiadloprid. For both end points, the exception of S. curviseta. The results suggest a specific mode of action of thiadloprid towards reproduction, a trend that has been found in all tests, except for H. nitidus that presented around the same sensitivity to both survival and reproduction. The species tested presented good control performance and consistency in the results, pointing towards a possibility to be used in toxicity tests.

558 Dirty dancing: measuring mit e move responses to pesticide residues J. Witton, Environment Dept, University of York / Environment; T. Alvarez, EcoRisk Solutions Ltd / Dept of Ecological Sciences; M. Reid, HSE Health and Safety Executive / Chemicals Regulation Division; G. Weyman, ADAMA; M. Hodson, University of York / Environment Department; R. Ashauer, University of York / Environment

For a pesticide to be registered for use, the lethal and sublethal effects on non-target arthropods (NTAs) must be studied. Sublethal effects such as behavioural changes have been reported in NTAs exposed to some pesticides, with avoidance behaviour – whereby individuals discontinue or significantly alter their activity in response to a pesticide – being of particular interest. More research is necessary to better understand pesticide avoidance behaviour so that population consequences of such behaviour can be estimated. We aimed to develop an efficient method to quantify changes in movement behaviour and identify avoidance behaviour in relation to pesticide exposure in the predatory mite Typhlodromus pyri, a model species and one of the most predominant species found in fruit orchards throughout Europe. Using video analysis, we exposed individual adult mites to 3 insecticidal active ingredients (acetamiprid, deltamethrin, dimethoate), each at 3 concentrations, and evaluated mit e movement behaviours when exposed to these in comparison to a control arena. We found that distances walked by mites were reduced by up to 87% compared to the control when exposed to 0.1 μg mL1, deltamethrin, and that 54% of individuals exhibited no movement at all after 3 hours, whereas 45% continued to move at one third of the control concentrations. When exposed to 18 μg mL1 acetamiprid mean distance covered fell by 34%; however, when exposed to 0.45 μg mL1 dimethoate the mean distance covered increased by 11%. No individuals...
exhibited avoidance behaviour when exposed to aceatiniprid or dimethoate. We report the variable effects of 3 insecticides on a range of standard movement behaviours in T. pyri, including distance walked, time moving/not moving, velocity and meandering behaviour. We also report avoidance behaviour measured as the time taken to become trapped in the test arena glue boundary due to attempts to escape the arena. Our results complement existing knowledge of sublethal pesticide effects in T. pyri by quantifying movement behaviour changes in T. pyri. We are also adding to the knowledge relating to avoidance behaviour which is an area of growing interest. We hope to improve the understanding of population-level consequences from changes in movement behaviours caused by pesticide exposure.

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Should oral exposure in Hypoaspis aculeifer tests be considered in order to keep them in Tier I test battery for ecological risk assessment of PPPs?

T. Natal-da-Luz, CFE - Centre for Functional Ecology / Department of Life Sciences; T. Gevaert, CFE Centre for Functional Ecology and Hogeschool Gent, Education, Health and Social Work, University College Ghent; C.S. Pereira, CFE - Centre for Functional Ecology / Department of Life Sciences University of Coimbra; M. Arena, ECT Oekotoxikologie GmbH / Institute for Technology Assessment and System Analysis ITAS; J. Römke, ECT Oekotoxikologie GmbH; B. Karaoğlan, German Environment Agency UBA; A. Wiemann, UBA Umweltbundesamt; W. Drost, Federal Environment Agency (UBA) / Chemicals Assessment and regulation of PBT (Persistent, Bioaccumulative and Toxic) substances, is necessary to ensure a high level of protection of human and animal health, and of the environment. In aquatic organisms, trigger values for the identification of bioaccumulative (“B”) and very bioaccumulative (“vB”) substances are bioconcentration factors (BCF) of >2000 and >5000, respectively, obtained from fish flow-through studies according to OECD 305. However, Annex XIII of the REACH regulation does not define similar trigger values for the bioaccumulation in the B assessment and to define trigger values for the bioaccumulation factor (BAF) obtained from bioaccumulation studies with terrestrial oligochaetes according to OECD 317 that are comparable to the B/vB criteria in the scope of the PBT guidance revision. For this aim, the study comprised the following soil via tight exposure routes, and invertebrates, makes the test with this species, as it is currently performed, not very useful for Tier I test battery. The current test protocol does not take into account the fact that H. aculeifer is a predatory species, and only considers exposure to contaminants via the direct, soil ingestion route. Therefore, an adaptation of the test performance, by including exposure via contaminated food, is necessary. The methods described in the standard protocol for mite reproduction test advise feeding the test organisms with fresh preys (e.g. cheese mites Tyrophagus putrescentiae) from uncontaminated breeding containers over the test period but, in a real scenario, this exposure is simultaneous for H. aculeifer and their preys. Thus, through this protocol, the toxicity of contaminants to H. aculeifer might be underestimated. The present study aimed to make the oral exposure of the contaminant as an exposure route to be considered in reproduction tests. Two reproduction tests with H. aculeifer were performed (OECD 226) using artificial soil spiked with increasing concentrations of Cu: 0, 450, 675, 1013, 1519, 2278, 3417 and 5126 mg kg⁻¹. Cheese mites were used as food in both tests but, while in one test cheese mites obtained from normal laboratory breeding cultures (clean preys) were added, in the other test, cheese mites previously exposed to Cu (pre-exposed preys) were used. Results showed that H. aculeifer fed with pre-exposed preys were more sensitive to Cu than mites fed with clean cheese mites. These data support the route of exposure responsible for the effects on reproduction tests with predatory mites for ERA of PPPs. This enhance the need for a revision of the procedures described in the standard protocol for mite reproduction test to avoid underestimation of toxicity of contaminants.

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Plant protection products in agricultural soils - Do active ingredients show a comparable pattern in worms and in soil?

T. Schmidt, IES Ltd / Ecotoxicology; H. Viric Gasparic, University of Zagreb Faculty of Agriculture / Department for Agricultural Zoology; R. Bazok, University of Zagreb Faculty of Agriculture / Department of Agricultural Zoology; S. Kimmel, Innovative Environmental Services (IES) Ltd. / Ecotoxicology; S. Hoger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology

The environmental risk assessment of plant protection products on soil organisms is mainly based on the outcome of laboratory and extended laboratory studies (EFSA 2017). However, the link from the laboratory to realistic field conditions over several seasons is not well established. Currently no validated trigger for bioaccumulation in soil is available (EFSA 2017). One testable approach for filling this gap is proposed by combining experimentally determined residue data from earthworms and data from degradation studies in the field. Earthworms were sampled at different seasons from eight fields in Croatia and analysed for 26 active ingredients. The concentrations of 26 analysed active ingredients were 0.000-0.247 mg/kg worm fresh weight with a mean of 0.005 mg/kg. The percentage of samples with values below the limit of detection (LOD), values below the limit of quantification (LOQ) = 0.001 mg/kg and values above LOQ was 29, 42 and 29 %, respectively. Based on publicly available draft assessment reports from EC and EFSA, degradation parameters (DT₉₀, DT₅₀) were used to calculate degradation curves and the current concentration in soil at the date of worm sampling. By comparing analysed residues in worms and calculated concentrations in soil, a substance-specific bioaccumulation factor could be calculated. In the case of imidacloprid, the analysed residue levels in earthworm samples from the fields tended to increase with time whereas the calculated concentrations in soil decreased with time as expected, resulting in a supposed increasing bioaccumulation potential of imidacloprid under field conditions. The procedure proposed here – in the absence of analysed soil data – is a simple estimation which combines field history data with data from publicly available draft assessment reports. This approach may be useful for the assessment of the bioaccumulation potential of an active ingredient from a plant protection product under realistic field conditions.

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PBT assessment of substances - Proposal of a trigger value for bioaccumulation in terrestrial oligochaetes

M. Simon, Fraunhofer IME / Applied Ecology; C. Schlechtriem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; P. Egeler, ECT Oekotoxikologie GmbH / Institute for Technology Assessment and System Analysis ITAS; J. Römke, ECT Oekotoxikologie GmbH; B. Karaoğlan, German Environment Agency UBA; A. Wiemann, UBA Umweltbundesamt; W. Drost, Federal Environment Agency (UBA) / Chemicals Assessment and regulation of PBT (Persistent, Bioaccumulative and Toxic) substances, is necessary to ensure a high level of protection of human and animal health, and of the environment. In aquatic organisms, trigger values for the identification of bioaccumulative (“B”) and very bioaccumulative (“vB”) substances are bioconcentration factors (BCF) of >2000 and >5000, respectively, obtained from fish flow-through studies according to OECD 305. However, Annex XIII of the REACH regulation does not define similar trigger values for the bioaccumulation in the B assessment and to define trigger values for the bioaccumulation factor (BAF) obtained from bioaccumulation studies with terrestrial oligochaetes according to OECD 317 that are comparable to the B/vB criteria in the scope of the PBT guidance revision. For this aim, the study comprised the following soil via tight exposure routes, and invertebrates, makes the test with this species, as it is currently performed, not very useful for Tier I test battery. The current test protocol does not take into account the fact that H. aculeifer is a predatory species, and only considers exposure to contaminants via the direct, soil ingestion route. Therefore, an adaptation of the test performance, by including exposure via contaminated food, is necessary. The methods described in the standard protocol for mite reproduction test advise feeding the test organisms with fresh preys (e.g. cheese mites Tyrophagus putrescentiae) from uncontaminated breeding containers over the test period but, in a real scenario, this exposure is simultaneous for H. aculeifer and their preys. Thus, through this protocol, the toxicity of contaminants to H. aculeifer might be underestimated. The present study aimed to make the variable oral exposure of the contaminant as an exposure route to be considered in reproduction tests. Two reproduction tests with H. aculeifer were performed (OECD 226) using artificial soil spiked with increasing concentrations of Cu: 0, 450, 675, 1013, 1519, 2278, 3417 and 5126 mg kg⁻¹. Cheese mites were used as food in both tests but, while in one test cheese mites obtained from normal laboratory breeding cultures (clean preys) were added, in the other test, cheese mites previously exposed to Cu (pre-exposed preys) were used. Results showed that H. aculeifer fed with pre-exposed preys were more sensitive to Cu than mites fed with clean cheese mites. These data support the route of exposure responsible for the effects on reproduction tests with predatory mites for ERA of PPPs. This enhance the need for a revision of the procedures described in the standard protocol for mite reproduction test to avoid underestimation of toxicity of contaminants.

Challenges, methodological developments and practical solutions for Social Life Cycle Assessment in industry and policy

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Developments and recommendations on the practical use of Social LCA

S. Di Cesare, CRAB / Department of Economic Studies; A. Zamagni, Ecoinnovazione / LCA and Ecodesign Laboratory; J. Garcia, SCORE LCA; F. Silveri, University of Chieti-Pescara / Department of Economic Studies; A. Lanfranconi, Ecoact; L. Petti, University of Chieti-Pescara / Department of Economic Studies

Social Life Cycle Assessment (S-LCA) is a multi-criteria, multi-stakeholder and multi-methodology approach that provides useful, transparent and science-based information on social and socioeconomic performance of a product throughout its entire life cycle. In this study, a systematic literature review was carried out dealt with within these aspects: the scope of S-LCA, its purpose, the social dimension outside S-LCA (i.e., analytical tools, procedural and managerial tools, currently used for monitoring, assessing, reporting and communicating social aspects, and their main differences with respect to S-LCA); impact assessment methods; users and uses of S-LCA. In addition, an experimentation was conducted through a practical case study based on literature, with the following goals: (1) to test the applicability and practicality of S-LCA in a real-life context; (2) to highlight the methodology to identify social hotspots along the whole life cycle, and in particular in the remaining phases of the life cycle, such as raw material production and end-of-life; (3) to show how those results may complete environmental LCA and other social approaches. The product chosen is a Photovoltaic (PV) Module. The analysis carried out clearly pointed out that S-LCA is an evolving field, and main developments are envisaged, both at the level of methodology and results interpretation and communication. More in detail, the main limits of the S-LCA methodology identified in this analysis are
related to: methodological framework for S-LCA, goal&scope definition (in particular regarding the system boundary definition), data access, and use of qualitative data, methodologies and selection of indicators for the impact assessment phase. The strengths of the methodology are related to its capability of making the assessment of the product more complete, adding its social aspects to the environmental and economic ones, in addition to the increased transparency and traceability of the along the value chain. On the basis of the main challenges for S-LCA identified in this study, recommendations were identified, for further development and implementation of the methodology. The implemented study showed that there is a need for broad improvements of both methodological and communicative issues. To carry out a S-LCA study could be a way to manage social risk thanks to the identification of social hotspots, and to help companies building a targeted strategy for future development of social policies.

563 TBD

564 Social significance analysis of products - considering negative and positive social impacts along the supply chain of leather products
S. Neugebauer, RWTH Aachen University / INAB - Institute for Sustainability in Civil Engineering; M. Traverso, RWTH Aachen
Group of researchers is especially dealing with positive and negative social impacts of products along the value chain and for the supply chain. In order to determine social impacts occurring during the leather production processes, social life cycle assessment’s (S-LCA) implementation is of major importance. Practical imitations have to consider indicators and impacts determining social hotspots along the leather supply chain and should in addition provide information on social challenges and choices by means of negative and also positive social impacts. When assessing products’ life cycles the inclusion of positive social impacts is crucial, as most of the S-LCA indicators can be both positive or negative. Thus, this study aims at providing a social significance analysis (SSA) determining social hotspots along the leather supply chain and considering social impacts including positive as well as negative consequences. Existing social indicators are included, addressing relevant stakeholder groups and impact pathways, e.g. fair wage. New indicators are defined where needed, e.g. to represent the rights for indigenous people affected. The assessments are performed by means of secondary databases, e.g. Social Hotspot Database, and by including primary data gathered at production sites of the European leather producer. The results will provide the challenges and changes of European leather production including the different stakeholder groups affected (e.g. workers) but also positive/negative directions of each social impact category identified (e.g. fair wage as a positive and negative indicator and utility as a purely positive indicator). The SSA is based on the S-LCA of European leather production using life cycle assessment software and addressing critical aspects of the supply chain, e.g. existence of labor laws. Relevant social hotspots are identified. Depending on the indicator direction, social consequences (e.g. benefits in societal health resulting from non-exhausting work hours) can be determined for the stakeholder groups.

565 Integration of sustainability in industrial research and innovation: perspectives from ArcelorMittal's experience
A. Hettenger, M. Caraty, R. Turconi, ArcelorMittal / Sustainability RD; P. Cortijo, Utopies
The iron and steel industry is both a large contributor to greenhouse gases emissions and a provider of a key material for society's development, being used in a wide range of market sectors such as infrastructure, transport, construction and packaging. Because of its complexity and complexity, it is often difficult to assess. Sustainable development is essential to ensure efficient production processes, optimizing the use of resources, valorization of byproducts, but also to explore the other stages of lifecycle of products that use steel, i.e. to adopt the holistic approach of Life Cycle Assessment. Lifecycle thinking enables ArcelorMittal - the world's largest steel producer - to promote sustainability not only in its own operations but also in the use of its products by customers. In addition, the company also has a research team dedicated to sustainability and lifecycle assessment has been supporting the process and product research within the group. However, with more than 1,000 researchers in 12 research centers globally and hundreds of projects carried out every year, it is impossible for a single team to cover systematically the research performed. To this goal, the “Sustainable Innovation Tool” has been developed to enable the researchers of the group to self-assess their projects sustainability. Using the tool, they evaluate environmental and social aspects of their new processes and products and engage in a learning curve for an improved sustainable performance. The presentation will describe the collaborative development of the tool, the different phases of testing and the current start of the deployment across 6 research programs. We will draw on this experience to provide elements that supported its success, pitfalls to avoid. The company is at the start of this journey and seeks a continuous progress, and possible paths for a better integration between our current assessment of industrial research and generic frameworks such as the sustainable development goals will be discussed.

566 Social footprint of a packaging waste deposit-refund system in Spain
J. Muñoz, 2.0 LCA consultants; B. Weidema, Aalborg University; A. Bala, UNESCO Chair in Life Cycle and Climate Change (ESCI-UPF) / UNESCO Chair in Life Cycle and Climate Change, Escuela Superior de Comerc, Internacional ESCI; P. Fullana, Universitat Pompeu Fabra UPF / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerc, Internacional ESCI
We present a social footprint assessment of implementing a deposit-refund system (DRS) applied to beverage packaging waste in Spain. In a DRS consumers pay a certain amount in concept of “packaging deposit” added to the price of a product and receive the refund back when they return the used packaging. The social footprint developed by [Weidema et al., 2011] is an example of how to sum up social cost of income redistribution and the sum of all productivity-reducing externalities related to an activity. It is calculated by a top-down approach using input-output data. This method can be understood as a ‘streamlined’ social LCA. We applied its two general components: the income redistribution impact (IR): the increase (or loss, if negative) in utility caused by the transfer of money from one societal group to another, and the productivity impact (loss) from missing governance (PG): the difference between the actual purchasing-power corrected value added and the potential value added when all productivity impacts are internalized. The social footprint of an activity can be defined as $S = IR - PG$. We compared two scenarios, namely the current situation for household packaging waste in Spain in 2014 (system A), and a hypothetical scenario (system B) where a DRS is implemented. The functional unit was the total amount of packaging waste to be managed annually. Primary data for the two scenarios were obtained from the environmental and economic studies performed as part of this project. Data to quantify the social footprint were obtained from the database Exiobase v.3.3.10, which was implemented in the software SimaPro. The results show that the social footprint for both systems involves a net social benefit. However system B reduces this benefit by 5% compared to system A. Introducing this DRS system in Spain is expected to lead to a net loss in social benefit compared to the existing system. The social benefit of the increased recycling is more than outweighed by the social costs induced by the activities required to achieve these higher recycling rates (collection manually or automatically of packaging waste in shops and supermarkets and the associated transport). The social footprint, together with a powerful tool like Exiobase, can pave the way for an operational approach to social LCA, avoiding excessive data requirements and the long lists of impact indicators currently proposed for bottom-up approaches.

567 Poster spotlight: TH226, TH227, TH228
Developments in the use of bioassays for chemical and environmental risk assessment (I)

568 Application of Equilibrium and Toxicokinetic Models to Understand the Behaviour of Organic Chemicals in In Vitro Toxicity Tests
J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology
Toxicity testing in the 21st century is expected to rely increasingly on in vitro assays, which now cover a wide range of endpoints including cytotoxicity, receptor binding, protein interactions and DNA binding. In most cases, dose-response relationships from in vitro toxicity tests are reported using nominal concentrations in the test medium despite the known challenges such data introduce for comparing results across different test conditions and between different chemicals and for quantitative in vitro in vivo extrapolation (QIVIVE), Equilibrium partitioning (EQP) and toxicokinetic (TK) models have been proposed in the literature to address some of these issues. The main limitation of equilibrium partitioning models is that instantaneous distribution is assumed and hence uptake kinetics into cells/tissue, cell growth/division and the potential for degradation in the test system cannot be directly included in the calculations. The main objective of this study was to develop a toxicokinetic model (TK) for simulating the behaviour of organic chemicals in in vitro toxicity tests and compare the results to a previously developed EQP model. The toxicokinetic model was applied to a set of hypothetical microbial organic chemicals under different scenarios (e.g., biotransformation half-life) and then the results compared with a previously developed in vitro mass balance modeling tool based solely on equilibrium partitioning. We also applied the
EQP model to a specific ToxCast assay (ACEA_T47D_80hr_negative assay; cytotoxicity) to illustrate the value of the modelling approaches for QIVIVE and hazard/risk assessment. For relatively persistent chemicals (or in cells/tissue with limited metabolic competency), the simulated mass distribution using the toxicokinetic model is similar to the equilibrium partitioning model output for test durations greater than 12 h. In such cases, the EQP modeling approach is deemed suitable for use in exposure assessment for static exposure to static experimental reliable toxicity metrics for QIVIVE (e.g., membrane concentrations). Of the 306 chemicals included in the ACEA_T47D_80hr-negative assay simulations, approximately 2/3rds had predicted membrane concentrations in the range expected to result in baseline toxicity (membrane dysfunction/narcosis). Chemicals with predicted membrane concentrations well below the baseline toxicity range may act via a specific mode of action and could therefore be prioritized for further investigation.

Experimental exposure assessment in in vitro bioassays for organic acids

L. Henneberger, Helmholtz centre for environmental research - UFZ / Cell Toxicology; M. Mühlenbrink, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; F. Fischer, Helmholtz Centre for Environmental Research GmbH - UFZ; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology

Improved assessment of exposure in in vitro toxicity assays is essential for the application of in vitro data for chemical risk assessment. Equilibrium mass balance models have been developed to convert the reported nominal effect concentrations of experimental exposure to toxicologically relevant concentrations (C_{eq}), which are considered more meaningful dose metrics than nominal concentrations. In vitro exposure assessment might be challenging for pesticides and pharmaceuticals that are acid dissociable, due to their unusual partitioning behaviour. Hydrophobic acids are typical ligands for serum albumin and are consequently strongly bound to medium proteins in in vitro assays, while the results of dynamic equilibrium models are reliable models are available to calculate the binding of neutral chemicals to lipid, protein, medium and cells, the binding of organic acids to biological matrices cannot be easily predicted. Here we applied a phase partitioning method to measure binding of organic acids to biological matrices like cell culture media and cell suspensions on the one hand, but also for direct measurement of exposure (i.e., C_{eq}). Because polymers like polydimethylsiloxane that are typically used for solid phase microextraction (SPME) are not suitable for charged chemicals, C18-coated SPME fibres were used for this study, since it has been previously reported to have high sorption capacities for charged chemicals. Eight organic acids were chosen for the experiments: diclofenac, 2,4-D, ibuprofen, naproxen, tartrazin, warfarin, trimoxazol, and gentamicin. For all chemicals, equilibrium between the SPME fibre and water was established within 4 h and the determined fibre-water distribution ratios were reproducible (SD ±0.1 log units). Because the sorption of some of the chemicals to the fibres was concentration dependent, it was required to calibrate the fibres for the desired concentration range. The SPME method was applied to measure C_{eq} in cell culture media. At low chemical concentrations the results from the binding experiments agreed with the predictions from a mass balance or modelling approach. However, saturation of the medium was observed at high chemical concentrations and further experiments will be necessary to investigate for which chemicals and at which concentration levels saturation occurs and if it is required to incorporate non-linear binding into existing exposure models for in vitro bioassays.

A new paradigm in water sampling - how can we challenge the needs of effect-based monitoring?

T. Schulze, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; L. Beckers, Helmholtz-Zentrum für Umweltforschung GmbH - UFZ / Hydrogeochemistry and Water Quality, F. Fischer, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; M. Schumann, Universität Duisburg-Essen / Aquatic Ecology; F. Begnaud, Firmenich / DRAP; C. Debonneville, Firmenich / Research and Development; F. Bertha, T. Schulze, Firmenich SA / Zentrum für Umweltforschung GmbH - UFZ / Product Safety and Regulatory Affairs; K. Schirmer, Eawag / Environmental Toxicology

Permeation of organic chemicals from the aquatic environment across cellular barriers is a critical step for accumulation in organisms, such as fish. To better understand the underlying processes, we aim to study the role of the fish intestine as barrier for hydrophobic and volatile chemicals. The function of the intestine in these processes is experimentally impractical to assess on a routine basis. Additionally, hydrophobic and volatile chemicals are difficult to work with, due to their low water solubility and high volatility. Therefore, we here combine a recently developed in vitro epithelial barrier model using the rainbow trout (Oncorhynchus mykiss) intestinal cell line RTgutGC, and a newly constructed chamber that enables stable chemical exposure concentrations. In this setup, we measured the permeation of 10 fragrance compounds with a range of volatility (logHLC = -5.8 to -2.2) and hydrophobicity (logK_{OW} = 3.6 to 5.7). The RTgutGC monolayer partly presented a physical barrier for the permeation restricting the fragrance transfer from the apical to the basolateral compartment. The calculated permeation rates across the cell layer combined diffusion controlled permeation and intestinal biotransformation. The involvement of biotransformation within the cell monolayer was further supported by experiments at 4°C and the measurement of cell associated chemical concentration. We determined the chemical distribution in all different compartments of the monolayer, which correlated with the logK_{OW}. The chamber enabled stable exposure concentrations and close to full recovery at the basolateral boundary. Exposure time was limited with a flow-through approach to prevent the presence of a chemical sink in the basolateral maintained the concentration gradient and increased the permeation by approx. 1.5 to 3 times, depending on the logK_{OW}. At present, there are no comparable intestinal permeation data for fish available, which precludes a direct comparison of the in vitro measured rates with in vivo observation. However, exactly this unavailability of data highlights the importance of the development of such an in vitro technology for understanding the transport at the intestinal epithelium. Data derived with this barrier model can help to develop strategies to link in vitro permeation with the prediction of bioaccumulation factors for fish. Moreover, the well-defined exposure scenario in our system comprises a prerequisite for studying mechanisms underlying chemical permeation, such as active transport or biotransformation.
promising technology to overcome the disadvantages of traditional sampling techniques with respect to EBM. The first challenge is the demand of water to be enriched which is dependent from the number and extracts consumption of the bioassays used for the assessment. The second challenge is the recovery and carry-over of the potential toxicity from the water sample to the vessels or wells of the bioassay. The third challenge is the representativeness of the sample. The successful implementation of EBM strategies requires the availability of automated sampling devices which allow the sampling of larger water volumes, guarantee the sampling integrity and makes it possible to take representative samples over a longer period or during events such as heavy-rain- and flood-events. A solution to overcome the disadvantages of classical sampling methods and devices is the recently released LVSPe approach and apparatus. It brings the SPE onshore, allows fully automated sample processing and avoids the transport of larger water volumes to laboratory for filtration and extraction. LVSPe was comprehensively assessed with respect to recovery and carry-over of effects. It has been shown that LVSPe is applicable in monitoring and survey programs, to assess surface water and wastewater with effect-based tools and to unravel one of the causes of mutagenicity in the river Rhine using effect-directed analysis. Thus, LVSPe is a promising technology for the implementation of EBM for water quality monitoring in European and worldwide water quality monitoring. LVSPe is commercially available from MAXX GmbH. However, we declare no conflict of interests as all results presented are scientifically justified.

573 Prioritization of non-target screening suspects based on semi-quantitative concentrations and ToxCast in vitro toxicity data

M. Dingemanse, A. Brunner, KWR Watercycle Research Institute; K. Baken, KWR Watercycle Research Institute / CWG; A. van Wezel, Copernicus Institute Utrecht University

In addition to target analyses of chemicals in water samples, non-target analyses are increasingly being applied. The aim of this study was to develop an innovative prioritization tool for chemicals of emerging concern for drinking water, by combining HRMS data with high throughput toxicity data from EPA’s ToxCast database. To increase the health relevance of the prioritization method, both semi-quantitative concentrations (internal standard equivalents) in the water samples (as a measure of exposure) and toxicity classes based on 95th percentile AC50 values (as a measure of hazard) were included as these form the basis for health risk assessment. A procedure to collect chemical-specific toxicity data from the ToxCast database and a scoring methodology for detected suspects were developed and applied to different types of water samples (sewage treatment plant effluent, surface water, ground water and drinking water) to prioritize suspects for identification and further risk assessment. ToxCast data were collected from the EPA’s online Toxcast data repository. Assay endpoint AC50 values (the concentration at which 50% of the maximum response is achieved) were extracted from the ToxCast database for the tested chemicals (suspects). All ToxCast assays were included in this hypothesis-free analysis. To reduce the impact of very sensitive assay endpoints, the 95th percentile of the range of AC50 values of a suspect chemical in ToxCast assays was used as a measure of its toxicity. More than 7000 structures were detected in these water samples by HRMS non-target screening analyses, and these could be linked to >1000 suspects from a curated suspect list of >5000 EU and water relevant chemicals. The ToxCast database contains in vitro effect data for 549 of the 1073 suspects present in the water samples. Many suspects were prioritized based on toxicity and semi-quantitative exposure levels that were not prioritized earlier based on exceedance of the threshold of Toxicological Concern. After confirmation of their identity, the prioritized suspects are candidates for an in-depth risk assessment based on all available toxicity data, for introduction in monitoring programs or for further risk management measures. Standardization of prioritization schemes for suspect screening approaches may be needed for further introduction of these techniques in water quality regulations. Funded by the Joint Research Program of the Dutch water companies (BTO, project 400554-214).

From detection to action: advances in assessing and managing highly fluorinated compounds

574 Toward the Comprehensive Profiling of Zwitterionic, Cationic, and Anionic Perfluoroalkyl and Polyfluoroalkyl Substances in Firefighting Foam Impacted Soils

G. Munoz, Université de Montréal / Chemistry; P. Ray, Université Pierre et Marie Curie; S. Voy Duy, Université de Montréal / Chemistry; T. Do, Université de Montréal; S. Mergia, McGill University / Civil Engineering and Applied Mechanics; J. Liu, McGill University / Department of Civil Engineering; S. Sauvé, Université de Montréal / Chemistry

In recent years, the comprehensive analysis of both aqueous film forming foam (AFFF) formulations and environmental samples aided to reveal the identities of novel classes of perfluoroalkyl and polyfluoroalkyl substances (PFASs). Following the prioritization effort for firefighting training activities or fire emergency response, the soil is typically the first environmental compartment impacted. In such samples, newly identified PFASs could surpass the concentrations of legacy PFASs by orders of magnitude, indicating the need for in-depth characterization of their transport potential and effects in ecosystems. The methods currently available for the analysis of perfluoroalkyl acids (such as PFOS or PFOA) could, however, severely underperform for certain newly-identified PFASs. Severe discrepancies were noted as regards the extraction efficiency of cationic and zwitterionic PFASs between soils of variable textural class and organic matter (OM) content, which carries over into membrane filtration and results in great variability of quantification accuracy. Failure to obtain quantitative recoveries from soils/sediments could also preclude a reliable assessment of environmental fate properties (e.g., soil/water partitioning coefficients, biodegradation half-lives, bioconcentration factor). Given the aforementioned limitations, the present study set out to propose a suitable preparation procedure for the multi-residue analysis of PFASs in AFFF-impacted soils. A total of 89 PFASs, representing >20 distinct chemical classes previously discovered in AFFF formulations or across AFFF-impacted sites, was therefore evaluated. Multiple extraction methods were assayed to recover PFASs from AFFF-impacted soils and laboratory-derived soils. The optimized method was applied to a variety of water samples from firefighting training areas and AFFF applications and possess a lot of possible entry pathways that were identified in prior studies. Although, advertisement and material safety data sheets indicate a rather extensive use of PFASs in building materials and industrial textiles, only few studies deal with investigation of these materials. A total of 23 samples from products used in firefighting training and 28 industrial textiles have been investigated in the course of this project. Monitoring covered 29 PFASs with a chain length of C4 to C14, including carboxylic acids, sulfonic acids, sulfonamides and fluorotelomer alcohols. PFASs of diverse chain length (C4-C14) were detected in 31 of 51 investigated samples. Concentrations of perfluorooalky acids were up to 430 µg/kg for highly contaminated samples. FTFOHs were even detected in concentrations up to several mg/kg. However, FTOHs need to be further investigated since they may be false positives resulting from the low selectivity of utilized transition for FTOH quantification. In addition to performed investigations, rinse of samples of e.g. buildings should be performed to prove suggested entrance pathways. Furthermore, additional method development has to be performed in order to better illustrate entrance pathways.

575 Investigation of perfluoroalkyl and polyfluoroalkyl substances in products used for building industry as well as industrial textiles and their possible contribution to water contamination

R. Janssen, Hochschule Fresenius / University of Applied Sciences; S. Lebertz, SGS Institut Fresenius Germany; T. P. Knepper, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology

Perfluoralkyl and polyfluoroalkyl substances (PFASs) have been widely studied in environment, outdoor clothes and fire fighting foams. As a consequence of the hazardous environmental properties of some PFASs, such as persistence, bioaccumulation and toxicity, their fate has been widely discussed. Due to their water, dirt and moisture repelling properties, PFASs are suitable for a variety of applications and possess a lot of possible entry pathways that were identified in prior studies. Although, advertisement and material safety data sheets indicate a rather extensive use of PFASs in building materials and industrial textiles, only few studies deal with investigation of these materials. A total of 23 samples from products used in building industry and 28 industrial textiles have been investigated in the course of this project. Monitoring covered 29 PFASs with a chain length of C4 to C14, including carboxylic acids, sulfonic acids, sulfonamides and fluorotelomer alcohols. PFASs of diverse chain length (C4-C14) were detected in 31 of 51 investigated samples. Concentrations of perfluorooalky acids were up to 430 µg/kg for highly contaminated samples. FTFOHs were even detected in concentrations up to several mg/kg. However, FTOHs need to be further investigated since they may be false positives resulting from the low selectivity of utilized transition for FTOH quantification. In addition to performed investigations, rinse of samples of e.g. buildings should be performed to prove suggested entrance pathways. Furthermore, additional method development has to be performed in order to better illustrate entrance pathways.

576 The growing role of seafood consumption for exposures to legacy PFASs: Evidence in Longitudinal Birth Cohorts from the Faroe Islands

C. Dassuncao, X. Hu, Harvard University; F. Nielsen, University of Southern Denmark; P. Weihe, The Faroese Hospital System / Department of Occupational Medicine and Public Health; P. Grandjean, Harvard University; E.M. Sunderland, Harvard University / School of Engineering and Applied Sciences

Rapid declines in legacy poly- and perfluoroalkyl substances (PFASs) have been reported in human populations globally following changes in production since 2000. However, temporal shifts in exposure sources are not well understood and this is particularly important for mitigation of persistent PFASs. The concentrations of 19 PFASs (SPFASs) measured in children between 1993 to 2012 from a North Atlantic fishing community (Faro Islands) where pilot whale is part of the traditional diet. Median SPFAS concentrations in children (ages 5 to 13 years) peaked in 2000 (47.7 ng mL⁻¹) and declined significantly by 14.4% yr⁻¹ to 8.7 ng mL⁻¹ in 2012. Perfluorooarboxylic acids (PFCAs) with nine or more carbons (C₉-9) were strongly associated with mercury in children’s hair, a well-established proxy for seafood consumption, especially perfluoroundecanoic acid (PFUnDA, n = 0.72). Toxicoisometric modeling revealed PFAS exposures from seafood have become increasingly important (53% of perfluorooctane sulfonate: PFOS in 2012), despite a decline in whale consumption in recent years. A previous study reports PFASs in Faroese drinking water were below detection. We thus infer that even in a major seafood consuming population, PFAS concentrations in SPFASs exposure after 2000 were achieved by the rapid phase out of PFOS and its precursors in consumer products.
Membrane-water partition coefficients to aid PFAS risk assessment.
S. Droge, University of Amsterdam/IBED Institute / IBED

Widely varying structures of fluorinated compounds have been detected ubiquitously in humans and the environment. Due to the limited understanding of basic physical-chemical properties of any of these PFASs, risk assessment (RA) models still provide highly uncertain outcomes. Most PFASs are ionogenic, and act as surfactants. As a result, octanol-water partition coefficients ($K_{ow}$) cannot be determined experimentally. Due to the lack of experimental data, QSARs to predict $K_{ow}$ are not properly calibrated for any perfluorinated ionogenic compounds. Furthermore, the dissociation constant ($pK_a$) of PFASs has proven to be difficult to determine experimentally and is simply unknown for most emerging alternative PFASs. This may lead to high uncertainty on the fraction of ionized and neutral species at a certain environmental pH of emerging PFASs, and the link to the chemical’s “hydrophobicity”. One of the main applications of $K_{ow}$ value in RA models is to relate a chemical’s “hydrophobicity” to bioaccumulation and toxicity. It is therefore utmost surprising that hardly any data is available on measurements of sorption data to (phospho)lipid, for which assays are readily available and that lack all the concerns about experiments with octanol. Phospholipids are in general the key tissue component to sorbs ionogenic surfactants, and relate directly to baseline toxicity levels and bioaccumulation. The current study evaluates the results of two experimental tools to measure sorption of standard PFAS structures to artificial phospholipids: retention on immobilized phospholipid chromatographic column and solid supported lipid membranes. The current study also evaluated to what extent quantum-chemical software COSMOTherm, which does not require any experimental measurements, can be used to predict $K_{ow}$ of the membrane affinity of aionic perfluorinated surfactants. It shows promising predictions on $K_{ow}$ of alternative PFASs, e.g. Gen-PerF, but for the negative octafluorooctane sulfonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to a be neutral PFAS.

578 Impacts of ocean circulation on the marine PFOS burden in an era of geographically shifting emissions
C. Wagner, Harvard University / Harvard John A Paulson School of Engineering and Applied Sciences; C. Thackray, Harvard University / School of Engineering and Applied Sciences; X. Zhang, Wisconsin Department of Natural Resources / State Laboratory of Pollution Control and Resource Reuse, School of the Environment; E.M. Van der Kinderen, Harvard University, School of Engineering and Applied Sciences

Concerns over the persistence, bioaccumulation potential and toxicity in organisms prompted the inclusion of perfluorooctane sulfonate (PFOS) in the Stockholm Convention in 2009. The ocean is thought to be the terminal sink for most PFOS releases, and its concentration in marine waters not specifically targeted by regulations, but simply takes 3D-molecular charge densities into account, is able to predict for emerging PFASs both the membrane-water partitioning ($K_{ow}$) of the ionic perfluor species, and the predictions on $pK_a$. Whereas COSMOTherm accurately predicts $K_{ow}$ for cationic hydrocarbon surfactants, it strongly misinterprets the membrane affinity of anionic perfluorinated surfactants. It does show promising predictions on $pK_a$ of alternative PFASs, e.g. Gen-PerF, but for the negative octafluorooctane sulfonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to be a neutral PFAS.

579 PFAS pollution at airport sites: point and diffuse sources, fate and transport and remediation
S. Hile, G.D. Brovelli, Norwegian Geotechnical Institute

Using Norwegian airports and fjords as case study sites this work will present the identification of point and diffuse source PFAS inputs, the environmental behavior (partitioning) of these compounds in relation to their presence in soil, ground water, surface water and biota as well as suitable remediation methods for different sites. The once highly desirable physicochemical properties of PFASs (resistance to heat, water and oil) has led to a large-scale environmental problem as these properties go hand in hand with a low degradative potential, high persistence, high mobility and toxicity. At airport firefighting training facilities aqueous firefighting foams (AFFF) containing PFASs have been used in order to practice extinguishing fires. This has led to a point source input of pollution of soils, waters and biota in close proximity to these areas. The use of PFAS containing substances by the textile and paper making industries, as well as their presence in waste sent to landfills represent several diffuse source pollution pathways. The case studies presented encompass all of these inputs, and methods used to monitor the behavior of PFASs in soil, ground water, surface water and biota (including the use of passive samplers) will be described. Understanding the partitioning and leaching behavior of these compounds allows more informed regulatory decisions to be made and given that the regulation of PFAS is currently under the spot light this is of great importance. Perfluorooexane sulfonate were recently included on the list of Substances of Very High Concern in REACH. PFOS is included in the water framework directive and an environmental quality standard is often used in order to set clean up targets. The remediation of PFAS impacted sites presents unique challenges and current remediation of water often relies on pump and treat using activated carbon filters to sorb PFAS. There are fewer suitable remediation methods for soils. Through the case studies presented, different remediation methods that are currently being used in the field and lab (pump and treat and sorbent amendment) will be presented. Sorbent amendment has been shown to be a promising approach with reductions of PFAS reaching up to 99%.

Improvements in environmental exposure assessment: Development and application of tools across industry sectors, regulatory agencies, and international boundaries

580 Environmental fate and exposure models: Advances and challenges in 21st century chemical risk assessment
M. Scheringer, ETH Zurich / Institute for Chemical and Bioengineering; A. Di Guardo, University of Insurbia / Department of Science and High Technology; T. Gouin, TG Environmental Research / Safety and Environmental Assurance Centre; M. MacLeod, Stockholm University / Department of Environmental Science and Analytical Chemistry

Environmental fate and exposure models are a powerful means to integrate information on chemicals, their partitioning and degradation behaviour, the environmental scenario and the emissions in order to compile a picture of chemical distribution and fluxes in the multimedia environment. A 1995 pioneering book, resulting from a series of workshops among model developers and users, reported the main advantages and the identification needs for research in the field of multimedia fate models. Considerable efforts were devoted to their improvement in the past 25 years and many aspects were refined: the inclusion of nanomaterials among the modelled substances, the development of models at different spatial and temporal scales, the estimation of chemical properties and emission data, the incorporation of additional environmental media and processes, the integration of sensitivity and uncertainty analysis in the simulations, etc. However, some issues are still challenging and require research efforts and attention: the need of methods to estimate partition coefficients for polar and ionizable chemical in the environment, a better description of bioavailability in different environments as well as the requirement of injecting more ecological realism in exposure predictions to account for the diversity of ecosystem response and functional structure. In other cases such as the need for a more accurate assessment of emission sources, the number and nature of these needs is large, and the moves towards integrated assessment will have to be accompanied by improvements of the chemical emission inventories, the improvement of the exposure assessment models, the development of new tools for the assessment of environmental impact of chemicals, and the development of methods to implement the improved models in real ecosystem assessments.

581 Development and update of environmental exposure assessment tool EUSES for REACH and BPR Regulations
S. Frattini, ECHA-European Chemicals Agency; R. Cesa naitis, European Chemicals Agency; H. Schimmelpfenning, European Chemical Agency ECHA; H. Magaud, European Chemical Agency ECHA

Introduction Both REACH Regulation and the Biocidal Products Regulation requires that the chemicals addressed by the respective legislations are used safely. Both regulations require environmental exposure and risk assessment of chemicals. EUSES (the European Union System for the Evaluation of Substances) is a tool developed by authorities in the 90’s to support environmental exposure and risk assessment in line with the methods described in the technical guidance document (TGD 2003) that has treated the assessment practices for these three policy areas at that time. EUSES last relevant update was in 2004, so that the tool is now partly outdated. An update is needed since the availability of an up-to-date tool is critical for both REACH and the BPR to function efficiently, both for applicants/registrants, MSCAs and ECHA. EUSES has several modules (release, fate and distribution) that have to be updated. Release module has been updated to include all of these inputs, and met additional environmental m...
estimation capability of the model. Alignment of the exposure estimation methods to the scientific developments over the last 20 years. Implement the new module of SimpleTreat (4.0). Exploring how to address site specific assessment by EUSES, like for example within authorisation process. A process has been initiated by ECHA with stakeholders to assess the need for update of EUSES. The kick off for this update process is a workshop with stakeholders which will take place in ECHA, in April 2014. The expected outcome of the workshop is the identification and prioritisation of relevant updates to make EUSES up to date (scientifically and IT support/setting). Workshop outcomes planned to be available before May 2018 and will be presented to the wider audience of the SETAC conference.

582 Advances in exposure assessment of fertilizers: development of a fertilizers environmental exposure tool and generic exposure scenarios under REACH L. Della Pietra, Fertilizers Europe; S. Navis, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; R. Puska, Yara Suomi; M. Bjorgan, Yara International ASA; K. Oorts, ARCHE

Fertilizers are considered as formulations and therefore no registration or chemical safety assessment is required under REACH. However, use of the individual constituents needs to be covered in the chemical safety reports (CSR) of the respective substances. Currently, exposure and risk assessment of fertilizer uses is mainly described in a qualitative way because of the lack of appropriate environmental release categories (ERCs) and exposure models. Under the umbrella of the FARM REACH consortium, this paper presents an approach that has developed a fertilizer sector uses map. In addition, four sector specific ERCs (SPERCs) were developed, by grouping similar uses, mainly based upon their physical form and application mode. Next, a Fertilizers Environmental Exposure tool (FEE) tool was developed, since in the standard REACH models for environmental exposure assessment (EUSES, ECETOC TRA, CHESAR), no local scenarios for direct application to soil exist. A further group of models include under earth or synthetic fed state intestinal fluid (FeSSIF Fraction" (WAF) approach, but using relevant media i.e. deionised water for the environment or synthetic fed state intestinal fluid (FeSSIF – Biorelevant, Switzerland) to assess exposure routes via the gut (human health). Data is presented for different types of fertilizer substance which shows that most thickeners will not be bioaccessible and therefore, there will be minimal exposure to these substances. As the main form in which grease thickeners are manufactured and used, is

entrained in a grease base, it is proposed that a lack of exposure based on low solubilities and/or bioaccessibility is taken into consideration when registering the substances under REACH. This is a pragmatic approach for a group of substances that have low hazard potential and avoids conducting unnecessary vertebrate animal testing. The ERGTC strategy for registering grease thickeners under REACH, taking into consideration bioaccessibility, will be presented, including proposed “limits for leaching”. This approach could be expanded to include other types of similar substances which occur in situ in an inert carrier such as base oil

584 The durability criteria: a pragmatic and sound approach to the exposure assessment of nano-enabled agrochemicals M. L. M. van Megen, University of Victoria / Department of Environmental Geosciences; R.S. Kookana, CSIRO / Land and Water

After many years of research and development, nano-enabled agrochemicals are starting to make their way into the market. Evaluating nano-enabled agrochemicals against conventional analogues is essential to assess the new risks and benefits associated with the technology, and this raises a number of issues for regulators. The ecological risk assessment of nano-enabled agrochemicals is likely to differ from that of conventional products and new parameters are needed to allow an adequate evaluation of the new products. The majority of products currently in development consists in nanocarrier systems loaded with a registered AI. For this type of products, a priority for assessment is to establish the time during which the AI remains associated with the nanocarrier, i.e. the “durability” of the AI-nanocarrier complex (1). Koppen et al. (2) presented a series of guiding principles for the regulatory evaluation of environmental risk associated with nano-enabled pesticides, including a conceptual strategy relying on the durability parameter. A group drawn from regulatory agencies, academia, research, and the agrochemicals industry recently offered a perspective on relevant considerations pertaining to the problem formulation phase [3]. A case study (pendimethalin-entrained in a grease base, it is proposed that a lack of exposure based on low solubilities and/or bioaccessibility is taken into consideration when registering the substances under REACH. This is a pragmatic approach for a group of substances that have low hazard potential and avoids conducting unnecessary vertebrate animal testing. The ERGTC strategy for registering grease thickeners under REACH, taking into consideration bioaccessibility, will be presented, including proposed “limits for leaching”. This approach could be expanded to include other types of similar substances which occur in situ in an inert carrier such as base oil
Risk assessment of Nanomaterials: innovative approaches and application of recent research developments to regulatory science

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Regulatory tools and activities for environmental risk assessment of nanomaterials in ECHA


ECHA's current knowledge and experience will be used to encourage participation. A national expert panel will be consulted in multidisciplinary experts, the public and stakeholders. Online collaboration tools will inevitably touch on many issues faced by other countries and regulators. RAF will be a science based risk assessment framework (RAF) to guide legislative and regulatory risk assessments of nanomaterials under CEPA. This science based nanomaterials include identifying data needs, developing tailored strategies and potential harmful substances. Under the CMP, the current activities to address nanomaterials include identifying data needs, developing tailored strategies and approaches, work planning and strengthening collaboration with national and international partners and stakeholders. To support these efforts, Canada is developing a science based risk assessment framework (RAF) to guide legislative and regulatory risk assessments of nanomaterials under CEPA. This science based RAF will inevitably touch on many issues faced by other countries and regulators. Our communication strategy includes consultation and collaboration with multidisciplinary experts, the public and stakeholders. Online collaboration tools will be used to encourage participation. A national expert panel will be consulted in the spring 2018, and SETAC Europe would be the first attempt to reach out to the international scientific community for support. We hope to use this venue to generate new partnerships and to strengthen existing ones. Critical questions based on the challenges identified by Canada over much more than a decade of regulating new nanomaterials, and by the international scientific community looking at risk assessment challenges for nanomaterials, will be highlighted in this presentation.

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Building a Risk Assessment Framework for Nanomaterials in Canada

M. Sauve, Environment Canada; A. Shahsavaran, Environment and Climate Change Canada

Despite the potential benefits associated with the use of nanomaterials, concerns also exist regarding potential environmental and human health risks as a result of environmental exposure to nanomaterials. Canada regulates chemical substances, including nanomaterials, under various regulatory mechanisms. The Canadian Environmental Protection Act, 1999 (CEPA) and the Chemical Management Plan (CMP) are key in safeguarding Canadians and the Canadian environment from potentially harmful substances. Under the CMP, the current activities to address nanomaterials include identifying data needs, developing tailored strategies and approaches, work planning and strengthening collaboration with national and international partners and stakeholders. To support these efforts, Canada is developing a science based risk assessment framework (RAF) to guide legislative and regulatory risk assessments of nanomaterials under CEPA. This science based RAF will inevitably touch on many issues faced by other countries and regulators. Our communication strategy includes consultation and collaboration with multidisciplinary experts, the public and stakeholders. Online collaboration tools will be used to encourage participation. A national expert panel will be consulted in the spring 2018, and SETAC Europe would be the first attempt to reach out to the international scientific community for support. We hope to use this venue to generate new partnerships and to strengthen existing ones. Critical questions based on the challenges identified by Canada over much more than a decade of regulating new nanomaterials, and by the international scientific community looking at risk assessment challenges for nanomaterials, will be highlighted in this presentation.
nanomaterials contained in the sunscreen can be released into rivers, lakes, sea shores, and/or sewage treatment plants. Their fate and impact in these different systems is largely determined by the surface properties, i.e. the coating type and lifetime. This project aims to develop the eco-design of sunscreens through the minimization of risks associated with nanomaterials incorporated into the formulation. All stages of the cream life cycle must be considered in this light, from its manufacture to its end of life, through its use by the consumer and its impact on the environment. By considering each development stage of the sunscreen, from the choice of UV-blocker and its integration into a cosmetic formulation, to the knowledge of the risk involved in this choice all along the product lifecycle, an eco-design approach can be achieved and risk can be minimized. The present work combines industrial companies specialising in cosmetic formulation with academic research experts in the fields of exposure, toxicity and lifecycle assessment. Sunscreen fabrication, risk for the consumer by dermal exposure, risk for the direct aquatic environment and risk related to the end of life of the product are as many key steps of the sunscreen lifecycle that were investigated in this project.

591 Environmental risk assessment of engineered nano-SiO2, nano iron oxides, nano-CeO2, nano-Al2O3, and quantum dots

B. Nowack, EMPA; Y. Wang, Empa Swiss Federal Laboratories for Materials Science and Technology

Many research studies have aimed to investigate the ecotoxicological hazards of engineered nanomaterials (ENMs). However, little is known regarding the actual environmental risks of ENMs, combining both hazard and exposure data. The aim of this study is to quantify the environmental risks for nano-Al2O3, nano-SiO2, nano iron oxides, nano-CeO2, and quantum dots by comparing the predicted environmental concentrations (PEC) with the predicted no effect concentrations (PNEC). The PEC values of these five ENMs in fresh waters for 2020 in northern Europe and southeastern Europe were taken from a published dynamic probabilistic material flow analysis model. PNEC values were calculated using probabilistic species sensitivity distribution (PSSD). The order of the PNEC values was quantum dots < nano-CeO2 < nano iron oxides < nano-Al2O3 < nano-SiO2. The risks posed by these five ENMs were demonstrated to be in the reverse order: nano-Al2O3 > nano-SiO2 > nano iron oxides > nano-Al2O3 > quantum dots. However, all risk characterization values are four to eight orders of magnitude lower than one and no risk was therefore predicted for any of the investigated ENMs at the estimated release level in 2020. Compared to static models, the dynamic material flow model allowed us to use PEC values based on a more complex parameterization, considering a dynamic input over time and time-dependent release of ENMs. The PSSD approach makes it possible to include all available data to estimate hazards of ENMs by considering the whole range of variability between studies and material types. The risk assessment approach is therefore able to handle the uncertainty and variability associated with the collected data. The results of the current study are able to provide a scientific foundation for risk-based regulatory decisions of the investigated ENMs.

Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (I)

592 Occurrence of cyanotoxins in Greek lakes

A. Bousadiza, UMR CNRS EcoBio; M. Borman, UMR CNRS EcoBio / UMR Ecobio; C. Edwards, L. Lawton, Robert Gordon University / IDEAS Research Institute; E. Briand, IFREMER - Centre Atlantique / Laboratoire Phytoxoxines / Unité DYNECO / Dept. ODE; C. Wiegand, Université de Rennes 1 / UMR CNRS ECOBIO

Thanks to their adaptation cyanobacteria organized aquatic, marine and terrestrial environments. Eutrophication of waters has promoted and still increases cyanobacteria blooms in future, posing hazards to the aquatic ecosystem and human health due to the capability of cyanobacteria to produce bioactive or toxic compounds. One of the groups firstly affected by cyanobacteria is planktivorous zooplankton, such as Daphnia. On the other hand, Daphnia can also suppress cyanobacterial population up to certain density and toxicity. A development of tolerance apparently enables them to withstand cyanobacterial compounds, and is transferable to the next generation. The role of cyanobacterial toxins and other bioactive compounds has not yet fully been elucidated, neither has the question, if the presence of zooplankton grazers could modify their production. This study investigates the mutual two-way interactions, in terms of biochemical and life trait responses of both, cyanobacteria and daphnia. Microcystis aeruginosa PCC7806 cultures were used to assess the PEC, the PNEC and the D. magna were employed. In order to disentangle mutual interactions between both organisms, a co-culture chamber was designed, where two chambers are physically separated by a 0.2 µm cellulose nitrate membrane filter, preventing the grazing effect but allowing exchange of chemical compounds released into the medium. Exposures lasted one week. First results confirmed the detrimental impact of cyanobacterial metabolites released into their culture medium on D. magna. Cyanobacterial culture medium of M. aeruginosa PCC7806 obtained after 2 weeks culture, equivalent to 10⁷ cells/mL, reduced feeding and survival, moreover altered detoxification and antioxidant response as well as the energetic budget. Exposures to spent media from M. aeruginosa PCC7806 mice- are currently in progress. Vice versa, Microcystis aeruginosa PCC7806 was exposed to spent media from D. magna cultures of two weeks: During the first days there was an increase of growth rates, followed by a decrease in physiological performance. Moreover, the antioxidant response increased, which, even though not significant itself, caused a significant reduction in the hydrogenperoxide content in the cyanobacteria. First results indicate that cyanobacteria not only harm aquatic organisms, but that vice versa they react to the presence of potential grazers, hence yet unknown substances present in the spent media impair their performance.

594 Terragenic retinoid-like compounds produced by cyanobacteria into surface water

K. Hilscherova, Masaryk University, Faculty of Science, RECEUTOX / Research Centre for Toxic Compounds in the Environment RECETOX; E. Sychrova, Masaryk University, Faculty of Science, RECEUTOX / Research centre for toxic compounds in the environment; M. Kraus, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; A. Jonas, Masaryk University, RECEUTOX / Faculty of Science; J. Priebojova, Masaryk University, Faculty of Science, RECEUTOX / Research centre for toxic compounds in the environment; D. Grabek, Masaryk University, Faculty of Science, RECEUTOX; J. Vacekova, Masaryk University, Faculty of Science, RECEUTOX; L. Senhal, Masaryk University Faculty of Science RECEUTOX / RECETOX Research centre for toxic compounds in the environment; T. Prochazkova, Research Centre for Toxic Compounds in the Environment, Faculty of Science, Masaryk University / RECEUTOX, reacted to spent medium from “D. magna” cultures as the question, if cyanobacteria produce retinoid-like compounds. It has been well recognized that cyanobacteria are able to produce diverse groups of toxins. Recent reports show evidence of new toxic products of cyanobacterial metabolism - retinoid compounds, but there is very limited knowledge regarding to their producers, occurrence or potential associated risks. This research provides environmentally significant information about total retinoid-like activity in the biomass of cyanobacterial water blooms as well as in their surrounding water. It documents production of compounds with this bioactivity into the surface water by various cyanobacterial species. The level of retinoid-like activity reaches values that can cause adverse developmental effects in exposed organisms. Retinoid-like activity in cyanobacterial exudates was in a very good agreement with
developmental effects in zebrafish (Danio rerio) and frog (Xenopus laevis) embryos. Both the phenotypes and effective concentrations of exudates corresponded to all-trans retinoic acid (ATRA) equivalents, supporting the hypothesis that the teratogenic effects of cyanobacterial exudates are likely to be associated with retinoid-like activity. Non-target analyses and comparison of the spectra of compounds present in exudates with different retinoid-like activities pointed to structural features of compounds contributing to the retinoid-like activity. In the approach of a “virtual EDA” we have characterized in detail retinoid-like activity of 53 samples of exudates from 4 algae species and 15 cyanobacteria species/strains. Only several species of cyanobacteria showed detectable activity, while there was not activity in any algal exudates. We have identified a set of compounds that contribute to the total retinoid-like activity in both laboratory and field samples, including ATRA, 9/11cis retinoic acid, but also several novel cyanobacterial metabolites, such as 5,6epoxy-RA or 4keto-ATRA with high retinoid-like potency. In general, retinoid-like activity has been shown to be associated with cyanobacterial water blooms dominated by many different species, which documents that production of retinoids by cyanobacteria in the environment is a common phenomenon. This study was supported by the Czech Science Foundation project No.18-15199S and PF7 SOLUTIONS project No. 603437.

595 (Co-)Production Dynamics of Cyanobacterial Peptides
R. Sanches Natumis, E. Vonwyl, Eawag Swiss federal Institute of Aquatic Science and Technology / Department for Environmental Chemistry; E.M. Janssen, Eawag Swiss federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry

Cyanobacterial algal blooms are expanding temporally and spatially, which is promoted by eutrophication and likely climate change. Cyanobacteria can produce a wide range of bioactive compounds with different modes of action, including a variety of toxic peptides and other bioactive natural products. Information on the research production dynamics of the majority of novel cyanopeptides is mostly unknown even for common cyanobacterial strains. Such information is crucial to assess the risk of these emerging natural toxins for human health in evaluating their potential to reach drinking water supply plants. While it is known that many cyanopeptides are produced simultaneously from one species, the co-production of these potential toxins has not been explored comprehensively for cyanopeptides other than microcystins. This project focused specifically on the production and co-production dynamics of cyanopeptides from common cyanobacterial species including Microcystis aeruginosa and Anabaena flos-aquae strains. Batch culturing was done under varied environmental conditions and the cell abundance was followed by optical density, cell counting, and biomass and samples simultaneously, the cyanopeptide production was followed. Therefore, biomass extracts were purified and measured by liquid chromatography, high resolution mass spectrometry with refined analytical protocols. Comprehensive data analysis was performed to identify cyanopeptides and follow their abundance. These new insights of co-production dynamics are critical to better understand which peptides and peptide mixtures are present during cyanobacterial bloom events.


There are limited methods for the analyses of multiple algal toxins in aquatic food webs, phytoplankton, zooplankton, periphyton, macroinvertebrates, forage fish, bottom feeders and top carnivore fish. Algal toxins in freshwater systems do not necessarily occur as single contaminants; mixtures of toxins may be produced from Cyanobacteria, Prymnesium parvum (Prymnesin), and Euglena sanguinea, including microcystins, saxitoxins, cylindrospermopsin, anatoxin-a, prymnesin and euglenophycin. The objective of the first phase of this research was to spike environmentally relevant concentrations of microcystins into whole fish homogenates with 3 congeners of microcystins (LR, LA and RR) individually and as mixtures, and to develop a method for their recovery and measurement using the MMPB derivatization method. The second phase of the project is to field-test this method on fish collected from water bodies experiencing algal blooms and compare results with individual cyanogen measurements. Extraction methods and analytical methods were being developed for this research to enable recovery of multiple procedures for plankton, periphyton, and macroinvertebrates. Ten and 100 mg of fish homogenates from fish containing 1, 4 and 14% lipids were spiked with 4 and 40 ng of each of the microcystin congeners, LR, LA and RR. Various extraction techniques and conditions were tested to optimize recovery and simplify the procedure. Overall toxin recoveries were found to range from 30 to 50%. The lipid content was found to not interfere with generation of MMPB; however, it did impact the workup/extraction procedure in ways that were accountable through the use of a surrogate standard. The MMPB technique can be reliably employed for microcystin quantification in fish tissue. Detects in non-spiked samples (10-20 ug/kg) are comparable to literature precedent. For tissue quantification the MMPB method provides considerable improvements over extraction of individual toxin congeners and is consistent even with very polar or hydrophobic MCs.

597 Saponins in the aquatic environment: hydrolysis and toxicity
X. Jiang, University of Copenhagen; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences; B.W. Strobel, University of Copenhagen / Plant and Environmental Sciences; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences

Saponins are a class of bioactive natural compounds. Due to their detergent-like structure, saponins have a lot of applications, e.g. as biopesticides in crop protection. They may leach into the aquatic environment due to their low octanol/water partition coefficient and poor binding to organic matter. They may therefore pose a risk to the aquatic organisms. However, their fate and toxicity in the environment are not fully understood. Hence, we aim to investigate the pH and temperature dependence of saponins hydrolysis together with their dissipation in sampled lake waters and to determine the aquatic toxicity of saponins from quillaja bark, tea seed coat, and quinua seed coat towards different aquatic organisms. The hydrolysis of saponin (quillaja saponin) showed to be a highly pH dependent base-catalyzed reaction. The half-life was around 330 ±220 days at pH 5.1 and 26 ±, while decreased to 0.06 ±0.01 at pH 10.0. The hydrolysis was also influenced by temperature with an activation energy of 35.9 ±14.2 kJ/mol at pH 7.2. Lake waters with pH varying between 6.4 and 8.2 showed completely different hydrolysis patterns, with a fast initial dissipation of up to 60% of the initial saponin concentration, followed by an extremely slow to nil reaction, making saponin partially persistent in lake waters. The maximal concentrations protecting 95% of the aquatic species (HC50) derived from the SSD’s of saponins from quillaja bark, tea seed coat, and quinua seed coat were 2.91 ±1.00, 0.22 ±0.11 and 22.9 ±5.84 mg/L, respectively. The 100-fold difference in toxicity between the saponin-rich extracts from different plant species indicate that saponin toxicity depends on the species where it originates from, making “read-across” between saponins a dubious exercise. In addition, the predicted environmental concentrations of different saponins are close to or higher than their water quality standard, which means that the saponins might pose a risk to the aquatic environment if not used cautiously. Therefore, we recommend not using surrogate or expected data/conclusion in the regulation of saponin-rich plant extracts and pay more attention to the potential risk of saponins to the aquatic environment.

Advancing the Adverse Outcome Pathway Framework - An International Horizon Scanning Approach

598 Setting the Stage to Advance the Adverse Outcome Pathway Framework through Horizon Scanning
C. LaLong, U.S. EPA / Mid Continent Ecology Division; G.T. Ankle, U.S. EPA / National Health and Environmental Effects Research Laboratory; S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI); G. Hodges, Unilever / Safety and Environmental Assurance Centre SEAC; D. Knappen, University of Antwerp / Zebrafishlab Dept Veterinary Sciences; S. Munn, European Commission; I.J. Perkins, US Army Engineer Research and Development Center / Environmental Laboratory, B. Wolk, D.L. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory; M. Whelan, University of leicester / Geography; C. Willett, the Humane Society of the United States / Animal Research Issues; X. Zhang, Nanjing University / Environmental Science; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

Recognizing the international interest surrounding the adverse outcome pathway framework, which captures existing information describing causal linkages between a molecular initiating event through levels of biological organization to an adverse outcome of regulatory significance, an effort was undertaken to provide the scientific community the opportunity to engage in determining the direction of the AOP framework. Specifically, a horizon scanning effort was used to solicit questions from the international scientific community asking participants to propose questions that consider key outstanding challenges and/or limitations that must be overcome to advance the AOP framework for both research and regulatory decision making. From March-June, 2016, 340 valid questions were collected from 158 global submissions, spanning all continents, to an online horizon scanning survey. Respondents to the survey self-identified as 35% academia, 35% government, 20% industry, and 5% non-governmental organizations. Following a survey. Respondents to the survey self-identified as 35% academia, 35% government, 20% industry, and 5% non-governmental organizations. Following recognition of the horizon scan approach, four key themes emerged that could aid in guiding future AOP research and regulatory considerations, and AOP application. An expert survey. Recognizing the international interest surrounding the adverse outcome pathway framework, which captures existing information describing causal linkages between a molecular initiating event through levels of biological organization to an adverse outcome of regulatory significance, an effort was undertaken to provide the scientific community the opportunity to engage in determining the direction of the AOP framework. Specifically, a horizon scanning effort was used to solicit questions from the international scientific community asking participants to propose questions that consider key outstanding challenges and/or limitations that must be overcome to advance the AOP framework for both research and regulatory decision making. From March-June, 2016, 340 valid questions were collected from 158 global submissions, spanning all continents, to an online horizon scanning survey. Respondents to the survey self-identified as 35% academia, 35% government, 20% industry, and 5% non-governmental organizations. Following
their applications; regulatory use of the AOP framework, and expanding awareness of, involvement in; and acceptance of AOPs to support aspects of predictive toxicology and regulatory decision-making. Charge questions for each workgroup were directly modified from those submitted during horizon scanning. Additionally, from the horizon scanning exercise, frequently asked questions (FAQs) were identified and addressed by experts in the field. Together the horizon scanning, expert consensus, and the best evidence available were used to set the stage for the SETAC Pellston
described for their applications; regulatory use of the AOP framework, and expanding awareness of, involvement in; and acceptance of AOPs to support aspects of predictive toxicology and regulatory decision-making. Charge questions for each workgroup were directly modified from those submitted during horizon scanning. Additionally, from the horizon scanning exercise, frequently asked questions (FAQs) were identified and addressed by experts in the field. Together the horizon scanning, expert consensus, and the best evidence available were used to set the stage for the SETAC Pellston 2018 Workshop titled “Advancing the Adverse Outcome Pathway Concept: An International Horizon Scanning Approach,” that took place in Cornwall, Canada during April 2017. The contents of this presentation neither constitute nor necessarily reflect US EPA policy.

Adverse Outcome Pathway networks: development, analytics and applications

Adverse outcome pathways (AOPs) are an important framework that can help support more effective use of mechanistic, pathway-based, data in risk assessment and regulatory decision-making. AOPs have rapidly evolved from a conceptual paradigm into a formalized framework for organizing biological and toxicological knowledge and toxicological decision-making generally. In response to the recognized need to continue advancing the framework, SETAC sponsored a global horizon scanning exercise to identify major outstanding topics and challenges related to the AOP framework and its application. The development of guidance related to AOP network development and analysis was identified as a critical need. This report includes an inventory of current direct AOP network applications, but also on related topics such as mixture toxicity assessment and the implementation of feedback loops within the AOP framework. This presentation briefly outlines critical concepts concerning the development of AOP networks, how they may be analyzed, and illustrates how information derived from them can be applied. First, derivation of AOP networks is considered in the context of how it differs from development of animal models. Next, the application of filters and layers is discussed, which can be used to refine and enrich derived AOP networks so that they may be tailored to address specific questions of interest. We then introduce a number of analytical and computational approaches that may be used to characterize and analyze the structure of AOP networks to derive information that can guide research and regulatory decision-making. A number of application case studies is used to illustrate concepts underlying development and analysis of AOP networks, and how those concepts tie in with ultimate application. The contents of this presentation represent the personal opinions of the authors and neither constitute, nor necessarily reflect the policies or viewpoints of their employers or institutes.

Building and Applying Quantitative Adverse Outcome Pathway Models for Chemical Hazard and Risk Assessment

The adverse outcome pathway (AOP) framework serves as a knowledge and communication tool to facilitate translation of mechanistic (e.g., molecular, biochemical, histological) data into adverse apical outcomes meaningful to chemical risk assessment. Although initially designed for ecotoxicology applications, the framework has also received extensive attention relative to chemical safety assessments for human health. Moreover, as the AOP concept and associated knowledgebases have evolved, it has become recognized that the potential stakeholder community is broader than scientists and regulators directly involved in chemical safety assessment. For example, the application of AOP-based thinking for addressing biomedical challenges has become increasingly prevalent. This presentation will identify various stakeholders who currently, or potentially, benefit from application of the AOP framework and knowledge to specific needs, and describes challenges and strategies to effectively engaging these stakeholders. We also present a “roadmap” on how to maintain a viable, sustainable network to support AOP stakeholders, including recommendations for governance and coordination of AOP development and knowledge dissemination in a multi-stakeholder consortium. The contents of this abstract neither constitute, nor necessarily reflect, official USEPA policy.

Adverse Outcome Pathways: Moving from a scientific concept to a globally accepted framework

Advancing the Adverse Outcome Pathway (AOP) Concept – An International Horizon Scanning Approach,” in April 2017. The workshop addressed key challenges or limitations of AOP constructs as tools for informing research and regulatory decisions that were identified by responses to a global Horizon Scanning survey. This presentation will summarize the findings of Pellston Workgroup 3, which was tasked with the explication of practical considerations for this use of AOP constructs in regulatory decision making. The use of AOPs and related concepts have increased in scientific and regulatory sectors over the past decade, coinciding with pressures to find innovative solutions to evaluate chemical safety in a manner that better directs resource utilization. This workshop focused on how AOPs can be a useful tool for chemical decision makers in the government and private sector. At the various points where chemical decision making is employed across the “life” of a chemical – from research and development within the commercial sector, government registration and regulation, through to post-marketing use/stewardship – AOPs can be used as an organizing principle. Pragmatic evidence is provided for how AOPs can be and are currently being used in chemical decision-making processes. Considerations for evaluating the suitability of AOP for decision makers are discussed, recognizing that the acceptable level of uncertainty varies based upon the nature of the decision and the context in which it is being applied. The presentation provides multiple examples of AOP use and practical considerations for evaluating whether use of AOPs is fit-for-purpose in different circumstances. This abstract does not represent the views or policies of the U.S. EPA.

Ensuring Long-Term Utility of the AOP Framework and Knowledge for Chemical Risk Assessment

The adverse outcome pathway (AOP) framework provides a framework for organizing biological and toxicological knowledge according to a set of generally accepted principles and guidelines. In to post-marketing use/stewardship – AOPs can be used as an organizing principle. Pragmatic evidence is provided for how AOPs can be and are currently being used in chemical decision-making processes. Considerations for evaluating the suitability of AOP for decision makers are discussed, recognizing that the acceptable level of uncertainty varies based upon the nature of the decision and the context in which it is being applied. The presentation provides multiple examples of AOP use and practical considerations for evaluating whether use of AOPs is fit-for-purpose in different circumstances. This abstract does not represent the views or policies of the U.S. EPA.

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its introduction in 2010, it was recognized that a survey of the broader scientific community would be useful in identifying shortcomings and in guiding future initiatives. In 2016, we reached out to national and international scientific and regulatory communities to collect questions and provide an opportunity to discuss key outstanding challenges that must be addressed in order to realize the full potential of the AOP framework. Four key themes emerged from this “Horizon Environment” exercise (see presentation “Advancing the Adverse Outcome Pathway Framework - An International Horizon Scanning Approach” in this session), which were then addressed at a Society of Environmental Toxicology & Chemistry (SETAC) Pellaon Workshop comprised of international participants representing industry, government, academia, and NGOs was held in Cornwall, Ontario, in April 2017. This presentation will provide an overview of the overall outcomes and common themes that emerged during this Pellaon Workshop. In brief, common themes that spanned across these main topics included the need to simplify, translate, and better communicate the AOP framework to the broader international stakeholder community, and a consensus that the AOP framework does not represent a rigid tool but rather a knowledge repository for diverse stakeholders ranging from epidemiologists to mainstream experimental toxicologists to risk assessors and managers. Furthermore, when considering the AOP framework and its applications, the field of environmental toxicology and human health naturally merged into a continuum that is at the nexus of Toxicology in the 21st century. In particular, it was felt that the current momentum the AOP framework has gained across a wide range of professional sectors provides the unique window of opportunity to reach out to and gain acceptance of this framework by society, which will be required for it to become an integral part of the international chemical and environmental risk assessment landscape. The contents of this presentation neither constitute nor necessarily reflect US EPA policy.

Environmental specimen banks in research and regulation for a better environmental quality

604 Monitoring of POPs in the Baltic Sea ecosystem and in human milk

E. Nyberg, A. Biggert, S. Danielsson, Swedish Museum of Natural History; C. Ek, Department of Applied Environmental Science / Department of applied environmental science;

In the 1960s, the Baltic Sea was found to be severely polluted by persistent organic pollutants (POPs). These discoveries were the starting point of a continuous Swedish national monitoring program for contaminants in biological matrices, mainly from the marine and freshwater environment, with samples dated as far back in time as 1969. Today’s marine and freshwater monitoring programs consist of 32 lakes and 28 marine sites where matrices as perch, pike, arctic char, herring, cod, eelpout, blue mussel and egg from guillemot, oystercatcher and common tern are annually collected. In 1967, examination of human exposure to POPs was initiated by Karolinska Institutet in Stockholm through measurements in human milk from the area, and since 2007 milk has also been collected from Gothenburg in the southwest of Sweden. The milk samples were in 1997 transferred to the Environmental Specimen Bank at the Swedish Museum of Natural History. The main objectives of the monitoring program are to investigate changes over time, to estimate geographical differences and to assess compliances with set target values. Moreover, the program is designed to answer these different questions with a high statistical power. Since the start of the monitoring, concentrations of PCBs, DDTs, HCHs and HCB have decreased in fish and bird eggs from both the Baltic Sea and the Swedish freshwater environment. Several of the classical POPs have also decreased considerably in human milk. However, the non-linear trends differ between the monitoring matrices for several contaminants. In some cases the peak differs, and in others, concentration is levelling out for one matrix but continues to decrease for another. In addition, the concentrations of PCBs, DDTs and HCHs are, despite continuous decreases since the 1970’s, still higher in the Baltic Sea compared to, for example, the North Sea.

605 Jumping out of the frying pan and into the fire? Spatial and temporal trends for PBDE, Dechlorane Plus and alternative flame retardants in samples of the Gothenburg environmental specimen bank

A. Dreyeg, Eurofins Gfa GmbH / Air Monitoring; F. Neugebauer, Eurofins Gfa Lab Service GmbH / R&D; N. Lohmann, Eurofins Gfa LabService GmbH; M. Paulus, Trier University; H. Ruedel, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Department of Environmental Monitoring; C. Rauer, Umweltbundesamt / International Chemicals Management; J. Koschorreck, Umweltbundesamt;

In the last century, conventional brominated flame retardants (FRs) such as polybrominated diphenyl ethers (PBDEs) were identified as persistent organic pollutants and subsequently regulated. Novel or alternative FRs were introduced as their replacements to meet ongoing market demands. Many of these alternative FRs are also highly chlorinated or brominated and their fate and effects in the environment may be similar to those of their regulated counterparts. Until now there are only few comprehensive data sets about alternative FRs in the environment, particularly for Germany. In order to provide for a systematic overview about the current state of contamination of the German environment to FRs, a large set of terrestrial, freshwater and marine samples from the German environmental specimen bank were analysed for 45 FRs (PBDEs, Dechlorane Plus and brominated aromatics, brominated ethers, cyclic BFRs). The substances will be discussed with respect to their spatial occurrence in the environment (including different matrices as well as land use and ecosystem types), their substance patterns and potential future monitoring. Some results going back to the 1980s, e.g. from coastal herring gull eggs, freshwater fish, tree leaves and rye will be used to illustrate time trends for regulated flame retardants and their substitutes. Recommendations will be given to European and international chemical management.

606 New Uses of Archived Specimens from the U.S.A. NIST Marine Environmental Specimen Bank

R. Push, C. Bryan-Sallee, W. Davis, J. Lynch, B.A. Neely, J. Ness, S. Schuur, National Institute of Standards and Technology / Chemical Sciences Division The National Institute of Standards and Technology (NIST) has been involved in the long-term archival of biological and environmental specimens for over 40 years. Specimens originally intended for monitoring geographic and temporal trends in emerging contaminants as well as changes in transport and accumulation of legacy contaminants have added value today. Tissue and fluid specimens from marine animals, including mammals, seabirds, sea turtles, bivalves, fish, coral and coral ecosystems, collected through various projects are archived at the Marine Environmental Specimen Bank based in the Marine Biology Laboratory, in Charleston, South Carolina, USA, using standardized protocols for collecting, processing, and cryogenic storage. The protocols ensure a high quality sample is provided for downstream analysis that is fit-for-purpose and that homogeneous aliquots are uniform, reproducible, and stable over time. New investigations exploring if the standardized protocols, 1) affect the quality and suitability of RNA for gene expression studies; and 2) are feasible to use, have been started to evaluate trends in concentrations of perfluorinated alkyl acids (PFAAs) retro prospectively, using samples stored and processed in polytetrafluoroethylene (PTFE) based materials, have recently been conducted. In addition, alternative uses of these cryopreserved specimens including, 1) a detailed proteome profiling of tissues used to evaluate a new high-coverage well-sequenced genome, and 2) the discovery of using total nucleic acid as an alternate approach to genetic species identification, have also been conducted and will be discussed.

607 Monitoring of the indoor environment of ESB laboratories with selected target and non-target screening methods

P. Bohlin Nizzetto, Norwegian Institute for Air Research; M. Schlabach, A. Halse, P. Rostkowski, NILU Norwegian Institute for Air Research

The environmental specimen banks (ESBs) handle and store a wide range of high-quality samples with a main objective to perform retrospective analyses of newly identified contaminants (chemicals of emerging concern, CECs). It is of highest importance that the ESBs are able to monitor and document the indoor environment and not contaminated during handling and storage. Strict quality assurance (QA) protocols are applied at the individual ESBs, including specially dedicated laboratories, no use of personal-care products, cleaning routines and more. More complicated to control is the indoor air and dust in the laboratories and storage locations. Building materials and indoor objects may contain and further emit e.g. OCS or CECS to the indoor environment. To evaluate these trends in concentrations of perfluorinated alkyl acids (PFAAs) retrospectively, using samples stored and processed in polytetrafluoroethylene (PTFE) based materials, have recently been conducted. In addition, alternative uses of these cryopreserved specimens including, 1) a detailed proteome profiling of tissues used to evaluate a new high-coverage well-sequenced genome, and 2) the discovery of using total nucleic acid as an alternate approach to genetic species identification, have also been conducted and will be discussed.

608 DNA banking and its relevance for biodiversity research

J. Astrin, Zoological Research Museum Alexander Koenig

Within their genomes, the organisms on our planet contain an immense wealth of information about the diversity of life. These genomes conserve the code to identify organisms, comprehend population structures, etc. Fast progress in molecular technologies dramatically speeds up research on genetic biodiversity and increases the demand for professionally preserved and managed genome-quality samples in many disciplines, e.g. in ecology, conservation biology, etc. Biodiversity biobanks cater specifically to these demands, and in a standardized way. Environmental samples collected periodically by ESBs following defined routines constitute a very valuable source of DNA for biodiversity research, as they keep open a window that allows the parallel, correlative analysis of the chemical and of the species community composition of a given environment over time. Through species
Hazard and exposure assessment of chemical mixtures: steps towards increasing the realism of chemical risk assessment (II)

610 Poster spotlight: TH273, TH288, TH285

611 Environmental risk assessment of multiple stressors - chemicals and ionizing radiation
K. Petersen, NIVA - Norwegian Institute for Water Research; J. Brown, Norwegian Radiation Protection Authority; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

Increased focus on cumulative effects of pollutants in the environment has led to development of several methods for environmental risk assessment (ERA) of chemical mixtures and for ionizing radiation. Even though no generic impact and risk assessment model exists to accommodate different types of stressors (e.g. multiple stressors such as radiation, metals and organic compounds), larger harmonization and integration of approaches taken can be achieved to improve and combine the existing models for ERA of chemical mixtures and for ionizing radiation from radionuclides. Here we present a potential 2-tired approach for risk assessment of multiple stressors by assuming additivity of chemicals and ionizing radiation as a first approach in order to combine a framework for ERA of chemical mixtures with the ERA tool for ERA of radionuclides. The proposed approach was applied to a real case scenario: emission from decommissioning of old oil platforms performed on-shore close to Vatsfjorden (Norway). Several metals, NORMs and organic pollutants are monitored as part of the activity. Effect data for the monitored compounds were compiled from various databases and literature. The Tier 1 identified a cumulative environmental risk of the stressors, and several metals and organics had a risk quotient above 1 (preliminary data). The potential for a cumulative environmental risk was verified in Tier 2 where species group specific risk was investigated. Metals were identified as the main risk drivers for algae, crustaceans and fish, where fish was identified as the most sensitive species group for this exposure scenario. Based on the used exposure scenario, compiled effect data and the suggested approach for ERA of multiple stressors, a potential environmental risk was observed. The main challenges and uncertainties for the proposed approach are linked to exposure data in terms of speciation and bioavailability; time consuming and subjective effect data compilation and assumption of additivity of ionizing radiation and chemical stressors. The approach for estimating environmental risk of multiple stressors requires validation through experimental studies, but could already serve as a suitable tool for prioritization of stressors and organisms of concern, and to identify knowledge-gaps in terms of exposure and effect data. Acknowledgements: The project was funded from NRC project 223268 (CERAD) and in-kind from Norwegian Institute for Water Research (NIVA)

612 Assessing health risk associated with micro-pollutant mixtures in drinking water: an innovative combination of in vivo and in vitro assays and analytical screenings
Y. Levı, Univ. Paris Sud / ESE UMR 8079; J. Loret, o. schlosser, CIRSEE Suez Environment; a. guillon, Suez / CIRSEE; m. favier, INERIM Institut Cochon; v. domeragu, deptopont, Université Paris Sud; M. Binbot, V. Huteau, Univ. Paris-Sud / UMR ESE; m. plewa, b. marinas, University of Illinois at Urbana Champaign Assessing health risks associated with organic micropolllutants in drinking water is a major challenge for public health and improvement of the drinking water production units. Given the low concentrations, the diversity of emerging contaminants and chronic exposure, it is essential to combine chemical analysis with biotests. In vitro bioassays or in vivo tests on aquatic animals allow effect screenings but interpretation for health risk assessment is difficult. We have designed an innovative research program (to our knowledge, the first of its kind applied to drinking water) that aimed to simulate human life-long exposure to micro-pollutants in drinking water for in vivo tests on mammals... Over 4 seasons, we have concentrated by 100 the organic fraction from large volumes of 4 types of water: river water, drinking water produced by a treatment plant with this raw water, reverse osmosis and concentrated waste water. 2 generations of mice (10 males, 10 females for each type of water) were fed with concentrated water during a 1 year period, in order to reproduce in the animals, the exposure as a man drinking the water over 70 years. We carried out complete chemical analysis (quantitative targeted analysis, innovative non-targeted screening by HPLC and GC-2D with mass spectrometry), offering a new vision of the contaminants diversity. In vitro bioassays were used to evaluate environmental disrupting effects (ER and AR receptor), cell toxicity tests (mammalian and Microtox) and genotoxicity on CHO cell assay. Mice growth, survival rate and behavior in open field and in elevated plus maze were studied. Histological analysis on 19 organs and blood hormonal assays were performed. This complete and innovative protocol did not show significant difference of survival rate and growth between the four mice groups. In contrast, histological and hormonal effects were observed in the mice exposed to the raw river water concentrates as opposed to the mice exposed to the waters of better quality. Several tests suggested a greater sensitivity of the 2nd generation mice as compared with the 1st-generation. Biotests confirmed the overall good quality of the treated water, whatever the treatment process, despite the presence of organic micropolllutants. The presentation will show the detailed protocol and, Phaeocystis antarctica and Crystobacterium were allowed health risk assessment with regard to long-term exposure to real mixtures of organic pollutants in drinking water.

613 The application of DGT to assess the risk of metal mixtures in polar environments
D. Koppel, University of Wollongong / Chemistry; N. Adams, CSIRO; C.K. King, Australian Antarctic Division; D.F. Jolley, University of Wollongong / School of Chemistry

Contaminants predominantly occur in mixtures, posing a challenge to environmental management practices which are usually based on single-contaminant toxicity. Chemical interactions of the contaminants and non-specific biological responses to these mixtures may result in effects that differ from the sum of the toxicity of individual components. These differences can be classified as antagonism (less toxicity than expected from the sum of the individual contaminants in the mixture), non-interaction (toxicity equal to that expected from the sum of individual contaminants), synergism (toxicity greater than expected from the sum of individual contaminants). Diffusible Gradients in Thin-films (DGT) has been established as a robust method for analysing the biologically-available contaminants in situ and is well-positioned to assess the toxicity of contaminant mixtures. This study explores the use of DGT (with a Chlex®-100 resin) to assess the toxicity of Cd, Cu, Ni, Pb, and Zn in mixtures, to two common Antarctic marine microalgae, Phaeocystis antarctica and Cryothecomonas australis. Two metal exposure scenarios were considered: Non-interactive and synergistic toxicity were observed in the two algae species in response to increasing multiples of an environmental mixture (where the ratios of metals were based on reported concentrations at a historically contaminated Antarctic marine bay). Non-interactive toxicity was observed in response to an equitoxic mixture (five metals at their EC10 concentrations), as determined by Independent Action and Concentration Addition modelling. DGT measured concentrations were able to predict toxicity to the two algae at environmentally realistic contaminant concentrations. The use of DGT in Antarctica was validated by fielddeployments to sediments and waters of the near-shore coastal environment of a contaminated site around an Australian Antarctic research station. Their use in assessing the risk of historical contaminants to the polar environment is discussed.

614 Ecotoxicity testing of environmentally realistic contaminant mixtures using passive samplers: what can we learn from repeating toxicity tests over an extended period of time?
L. Moors, Ghent University (UGent) / Laboratory for Environmental Toxicology and Aquatic Ecology; F. Vuytsvkeghem, Ghent University / Sustainable Organic Chemistry and Technology; S. Huysman, Ghent University; K. Deemereete, Ghent University / Sustainable Organic Chemistry and Technology - Research Group EnVOC; L. Vanhaecke, Ghent University / Veterinary Public Health and Food Safety; H. Van Langenhove, Ghent University / Sustainable Organic Chemistry and Technology; C.R. Janssen, Ghent University / Applied Ecology and Environmental Biology; K. De Schampaere, Ghent University (UGent) / Applied Ecology and Environmental Biology

In current environmental risk assessment, researchers assess effects caused by single substances to single species and extrapolate for realistic conditions where organisms are usually exposed to complex contaminant mixtures. The use of passive sampling opens new possibilities to work with such mixtures and to transfer them into biotest systems by either applying passive dosing (for equilibrium based samplers) or extract spiking (for integrative samplers). Our research objective was to investigate whether or not environmentally realistic contaminant mixtures...
(ERCs) have effects on marine phytoplankton and how effects could be explained by measured contaminant concentrations. Further we looked at the repeatability of our test results over an extended time period of 16 months. In the presented research we used extracts of Speedisk™ passive samplers deployed in and outside of the harbor of Zeebrugge (Belgium) to spike several 72 h growth inhibition tests with the marine diatom Phaeodactylum tricornutum following ISO 10253. The different growth inhibition tests were performed over a period of 16 months with tests 0, 8 and 16 months after extraction. We observed statistically significant (p < 0.05) growth stimulation of up to 6.4 ± 0.5 % and 11 ± 2 % (in the harbour) and 7.0 ± 0.5 % and 14 ± 3 % (outside of the harbour) after an extract storage time of 0 and 8 months, respectively. After 16 months the previously observed effects disappeared completely. In order to explain the differing ecotoxicological responses a targeted and untargeted metabolite fingerprinting was performed in order to identify compounds of potential biological activity (e.g. pesticides, pharmaceuticals, (alkyl)phenols, phthalates and steroids). The analysis revealed that testing occurred at contaminant concentrations similar to those measured in water grab samples taken during sampler deployment. Remarkably the observed stimulation effects remained above 5 % when diluting the extracts up to 125 times. These findings suggest that P. tricornutum would remain affected by ERCMs even if their environmental concentrations would be reduced considerably. The disappearance of the observed stimulation effects after an extract storage time of 16 months led to the hypothesis that the main contributing contaminants causing stimulation must have degraded over time. In future work it would be of high interest to apply multivariate analysis (i.e. principal component analysis) to identify main contributing contaminants to the observed effects.

615 Marine Diatom Exposure to a Complex Mixtures of Fourteen Chemical Pollutants at Environmental Concentrations. What did we learn?

D. Napierska, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit; R. Carvalho, European Commission Joint Research Centre; A. Lahn, Bioinformatic consultant; S. Tasselli, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit; I. Sanseverino, European Commission Joint Research Centre; S. Balzano, M. Potalivo, ISPIRA Institute for Environmental Protection and Research; R. Loos, European Commission Joint Research Centre; D. Marinov, T. Lettieri, European Commission - Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

Thousands different chemicals are discharged into the environment from agriculture, industry, medical facilities, house-holds. Currently, there is an increasing concern for the environmental impact of mixture of compounds since the additive and eventual synergistic effects are unknown and could produce serious adverse effects. To address this issue, a joint-effort of 16 European and associated research groups participated to an exercise to test a 14-substance synthetic reference mixture at safety environmental concentration under the Water Framework Directive (Environmental Quality Standard, EQS). The mixture, was tested on the own routine bioassays to investigate the chemical mixtures effects (Carvalho et al., 2014). The bioassays covered the entire ecosystem from bacteria to fish as well in vitro assays providing an unique scenario from ecological risk assessment perspective. The results showed that effects were observed at very low concentration on algal-bacteria composition in a marine microcosm, immobilization in crustacean, fish embryo toxicity and frog embryo development. Transcriptomics analysis was performed for the marine diatom Thalassiosira pseudonana exposed either to single compound or the mixture to investigate whether the single exposure and multiple exposure would show different expression profile pattern. The results show that the mixture induces a pattern similar to the ones induced by the single herbicides Duron and Isoproturon. Signatures induced by the Cadmium or Nickel partially overlapped with the mixture signature. The exposure to the other compounds did in general not induce relevant signatures, although a weak overall consistent signature is present for some of them. In conclusion the effects of the mixtures could be explained mainly by the exposure to the two herbicides.

Advances in Soil Ecotoxicology and Risk Assessment of Terrestrial Ecosystems (II)

616 How protective is the current risk assessment for soil invertebrates?

P. Kotschik, Umweltbundesamt / Federal Agency of Environment / Risk assessment for plant protection products; J. Roemhke, ECT Oekotoxikologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences; T. Natal da Costa, University of Coimbra; S. Chelinho, CFE Centre for Functional Ecology / Department of Life Sciences of University of Coimbra; N. Capela, CFE Centre for Functional Ecology; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products

The present risk assessment evaluating effects from plant protection products (PPP) as well as other chemicals towards soil organisms encloses uncertainties. According to the recent developments on terrestrial ecotoxicology, the risk assessment for soil organisms exposed to PPP is based, in a first step, on results of standardised tests performed in artificial soil. This substrate is a mix of sand, peat, kaolinite clay and calcium carbonate and is not comparable to natural soils. However, limited data is available on the degree to which soil parameters influence the toxicity of chemicals for soil invertebrates in field soils, since toxicity is modulated by chemical sorption and bioavailability. Possibly, soil parameters like pH, organic matter content or texture, interact with each other in affecting the toxicity of different compounds to different soil organisms. These uncertainties in the current risk assessment methodology induce the necessity of better understanding of the toxicity of test chemicals for soil organisms in natural soils. A screening project has been initiated in spring 2016, comprising a literature review aiming to investigate the effects of soil properties on the impact of PPP’s on soil organisms. The practical part of the project included laboratory studies on Eisenia sp. and Folsomia sp. on 4 PPP in 5 different soils. The results showed deviations on toxicity values obtained for single substances in different soils up to factor 6.4. The highest differences were detected for Folsomia sp. exposed to the active substance Pendimethalin in OECD10% and Lufa 2.1, respectively. So, the current risk assessment schemes for soil organisms based on standard laboratory studies performed with the surrogate species Eisenia sp. as well as Folsomia sp. is not always protective. Uncertainties in the assessment do exist regarding the effects of chemicals in natural soils towards other soil organisms, and other varying soil parameters that have not been investigated systematically so far (e.g. pH, clay content and interaction between them). The conducted literature research as well as the performed laboratory studies should be classified as preparatory work for more comprehensive studies. Focus of the future research should be set on the identification of key parameters influencing toxicity in different groups of species in higher tier regulatory conceptual models allowing the extrapolation from the lab towards the field situation.

617 Risk assessment of soil organisms in field: dealing with earthworm community

Y. Bayona, F. Brulle, ANSES CNRS; A. Baptin, ANSES CNRS; For Plant Protection Products (PPP); Joint Expertise Risk assessment for soil organisms followed the Tiered Approach procedure. It covers worst-case situations (i.e. conservative estimates and toxicity laboratory studies) to the most realistic assessment (i.e. Field studies). The recent EFSA opinion proposed a framework for risk assessment of soil organisms and definition of protection goals. Still, no statistical tool was proposed when dealing with field studies as higher tier. The aim of this communication is to test tools routinely used for regulatory risk assessment of communities. The tools for the ecological communities were mostly developed for aquatic organisms risk assessment. The multivariate analysis (PRC) is used for the community comparison. Individual populations are compared date-by-date using various statistical analysis commonly including Dunnet test and Wilcoxon test. The main objective of this project was to test the PRC for the different species and functions the low number of replicates which could lead to false negative or false positive. The recently improved Minimum Detectable Difference is used to assess the robustness of the data used in these statistical tests. Then, through the analysis of results, we propose some lead and improvements for the soil community risk assessment, from the experimental design to the sampling choice and statistical analysis in the context of higher tier regulatory risk assessment of chemicals for earthworm and soil communities.

618 Metal soil threshold calculator tool: use of available data for derivation of metal soil quality standards for different scenarios and protection goals

K. Oorts, T. Lettieri, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

Metal soil threshold calculator tool: use of available data for derivation of metal soil quality standards for different scenarios and protection goals. During the last 2 decades, intensive research has been performed to improve the risk assessment of metals in soil and numerous chronic metal toxicity data were generated for various terrestrial species and microbial functions in different soil types. Models were developed for correction for differences in bioavailability among soils and for differences between laboratory and field conditions. For many metals, the large amount of chronic toxicity data for different species and functions allow the application of the species sensitivity distribution approach (SSD) to derive soil quality standards. This work was mainly triggered by the European regulation on chemical management (REACH) and the data were therefore prepared to derive no observed effect concentrations (NOEC) for different protection goals (e.g. remediation thresholds), jurisdictions, regions or sites, while still making maximal use of the wealth of data and models already available, a metal soil threshold calculator tool has been developed. This freely available spreadsheet reports almost 1200 reliable chronic toxicity data for the most direct effects of the metals Cd, Co, Cu, Pb, Mo, Ni and Zn to soil organisms (plants, invertebrates and microbial processes) and calculates ecotoxicological threshold concentrations expressed as (pseudo-)total (i.e. aqua-regia extractable) metal concentrations in soil (mg/kg dry weight). All metals covered have sufficient chronic toxicity data allowing the derivation of an SSD. The soils used for ecotoxicity testing cover for each metal a wide range of soil properties, making the results representative for most regions in the world. Several options are included to allow calculation of metal soil threshold concentrations for various goals (e.g. risk assessment or setting of remediation thresholds for different land uses): selection of organism groups or species to be considered, selection of
effect levels from the original dose-response curves (ECs), selection of protection level (probability level in SSD), bioavailability models to be included etc. The advantages of this approach are the maximal use of available toxicity data and bioavailability corrections and the enhanced transparency in the derivation of ecological quality standards for metals in soil for different goals and different scenarios.

619 Assessment of pesticides on a landscape level: What is basically needed? A. Toschki, Research Institute gaiac; M. Hammers-Wirtz, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; B. Scholz-Starke, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research

It is recently discussed and is widely accepted that species diversity and habitat quality dramatically decreased in the last decades due to the increasing intensity of agricultural land use. The decline was proved for various species groups, such as soil arthropods, insects, butterflies, birds etc. With the loss of species also a variety of benefits and ecosystem services that were provided by the species dropped away. The question arises that can be quoted as a decisive factor, but the all explaining reason for this unacceptable loss of biodiversity cannot be assigned easily to a single factor and is more due to a multifactorial complex of influences which is responsible as a whole. In current risk assessment procedures, single pesticides were authorized individually independent of the current status of biodiversity in the field and possible effects of the combined or sequential use. Additionally, there is no transferability in generating the use of pesticides on specific sites available. At the same time there is a lack of knowledge about the development of biodiversity in different agricultural landscapes because monitoring programs have not been established so far. The establishment of a systematic monitoring and a landscape risk assessment is necessary to connect future risk assessment with biodiversity as the protection target. Furthermore good ecological values must be derived and threshold for the life operating range must be defined. When the biodiversity level falls below the thresholds measures must be carried out. Geospatial models can help to optimise sustainable agricultural practice and measures for risk mitigation. The presentation will summarize result from different projects.

620 Potential new soil test requirements for the risk assessment of pesticides in the European Union: do we have the right methods? J. Roemhke, ECT Oekotoxikologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences

In February 2015, the European Food Safety Authority (EFSA) published a Scientific Opinion entitled "Scientific Opinion addressing the state of the science on risk assessment of plant protection products for in-soil organisms". This document summarizes various scientific issues relevant for the risk assessment of plant protection products (PPPs) for in-soil organisms, i.e. micro-organisms and invertebrates (plants are covered in another EFSA document). The aim of this document is to provide a systematic review and an evaluation of the use of pesticides in soil ecotoxicology, but – more importantly – it also summarizes the scientific background for a new approach. In the future, soil risk assessment should be based on the ecosystem service approach, meaning that important services at agricultural landscapes (e.g. nutrient cycling, soil structure maintenance, just to name a few) have to be protected. In consequence, protection goals for soil organism communities, i.e. their biodiversity and functions relevant for providing these services, have to be defined. This contribution will focus on one important question, assuming that the new risk assessment approach is put in practice: Do we have the appropriate (e.g., scientifically sound, robust, standardized) methods to cover the new data requirements? In this contribution we focus on four aspects of the new methodology: Organism groups, endpoints, soils, regions (i.e. agricultural practices are not covered). In fact, there are various research needs which have to be addressed asap, i.e. before the new requirements will be put in practice. We focus our discussion on those test systems which are already standardized (or which are in the process of being standardized in the foreseeable future). Besides OECD also methods published by ISO or national organisations such as Environment Canada are considered, knowing that the latter often have to be adapted in order to cover the specific needs of PPP environmental risk assessment schemes. In addition, the same criteria as in other comparable approaches will be used and examples of suitable methods will be given. Most important is whether they can be modified in a way that they are useful under the upcoming EFSA regulations.

621 Poster spotlight: TH154, TH155, TH156

Emerging technologies and related raw materials requirements scenarios: the role of life cycle thinking

Wood-fibres composite in substitution of a synthetic material to enhance sustainability purposes for automotive sector S. Maltese, Magneti Marelli Spa / Powertrain Division; a. bonoli, DICAM- Alma Mater Studiorum - University of Bologna / DICAM; L. Zanchi, M. Delogu, University of Florence / Department of Industrial Engineering

Nowaday bio-composite materials have increased automotive market penetration, which intend is to produce environmental friendly products while maintaining their competitive edge [1]. In particular wood-fibers is considered a more environmental friendly alternative to the synthetic reinforcements as talcum, glass and carbon fibers. The reason behind is due to their less impact on production issues (sharp reduction of toxic and fossil materials as well as for the energy expenditure, light-weight profile and more energy credit through their incineration [2-4]. This study presents the application of a newly engineered wood-based product, called Woodforce®, for the production of an automotive PedalBox Support (PBS); in particular, the environmental advantages/disadvantages are presented and discussed when such material is thought to substitute the glass fibres. At this scope, a comparative environmental analysis has been performed between two materials - a standard material (with glass-fibres content) and an innovative (with woodchip content) - which perform the same function. 1 Reference used in Maltese A., Carus M. 2016. Wood and natural fiber composites current trend in consumer goods and automotive parts. Reinforced Plastics 60: (3) 170-173. [2] Joshi S.V., Drzal L.T., Mohanty A.K., Arora S. 2003. Are natural fiber composites environmentally superior to glass fiber reinforced composites? Composites: Part A 35 (2004) 371– 376. [3] Boland S. Claire, De Kleine R., Keoleian G.A., Lee E.C., Kim H.C. Walle T., Donaldson T.J. 2015. Life Cycle Assessment of a PedalBox Support for Automotive Applications. Effects of Renewable Energy Content and Lightweighing. Journal of Industrial Ecology 20: (1) 179-189. [4] Holbery J., Houston D. 2006. Natural-Fiber-Reinforced Polymer Composites in Automotive Applications. Low-Cost Composites in Vehicle Manufacture. 623 Resource depletion of a Lithium ion battery cell technology M. Cusenza, Università degli Studi di Palermo; S. Bobba, G.A. Blengini, Politecnico di Torino; M. Cellura, M. Mistretta, University of Palermo Lithium-ion batteries (LIBs) are the dominating storage technology for electric vehicles (EVs). Different types of LIBs, using diverse cathode and anode materials, are available in the market, such as LiMnO2, Li(Ni1/3Co1/3Mn1/3)O2. The cathodes contain a wide range of raw materials (RMs), among which e.g. cobalt is in the 2017 list of CRMs for the Europe Union (EU). CRMs are both of high economic importance for the EU, and vulnerable to supply security. In the last years, the increasing demand of LIBs has triggered a growing interest in the need to ensure the security and the sustainability of the supply of the raw materials used in LIBs and in general in EVs. In this context, lithium rich layered oxides from the class xLiMnO2-(1-x)Li2O (M=Co, Mn, known as LNO – NCM, have drawn attention as cathode material due to their high discharge capacity and lower cobalt content, compared with the Ni-Co-Mn cathodes (NMC). In this context, the authors carried out a Life Cycle Assessment of an 11.4 kwh LMO-NMC battery cells used in plug-in EVs with the objective to quantify the impact of the mineral, fossil and renewable resources depletion (MFRRD); to estimate the requirement of CRMs; to identify the contribution of each cell component to the MFRRD; to compare the LMO-NMC LIB cell technology with an NMC cell technology available in the literature, with reference to the MFRRD and CRMs requirement. The LMO-NMC battery cell technology is modelled as 0.5LiMnO2 – (0.5Ni1/3Co1/3Mn1/3)O2 using both primary and secondary data. The cells of the 11.4 kwh LMO-NMC battery are selected as functional unit. The system boundaries include RMs supply, manufacturing, transports and infrastructures. The results show that the LMO-NMC cells have an impact on MFRRD of 0.34 kg Sb eq. The relevant share of MFRRD (34%) is caused by the cobalt sulphate production used in the cathode. Of the 27 CRMs for the EU, the analysis shows the relevance of only two of them: cobalt and barite. From the comparison with the NMC cell, carried out with reference to 1 kwh of nominal capacity, results that the MFRRD impact and the cobalt requirement of the LMO-NMC technology is lower, respectively, of a percentage equal to -4.4% and -29% than those of the NMC. The results indicate that the LMO-NMC cell could be a suitable technology to meet the demand of the EV market as it involves a lower impact on MFRRD and a lower consume of CRMs compared to the NMC cell.

624 Analysing the environmental impacts of alternative solutions for passenger transportation: LCA of a charging station for e-bicycles G. Carlesso, University of Roma Tre / Department of Business Studies; R. Salomone, L. Giuttari, G. Saia, G. Ioppolo, University of Messina / Department of Economics; M.C. Lucchetti, University of Roma Tre / Department of Business Studies

The transport sector causes environmental impacts that are mainly connected to the passenger car activities. In this context, strategies for reducing the environmental impacts related to the transport sector are required moving from cars to alternative transport vehicles, such as electric bicycles. Although many studies have been focused on the application of the Life Cycle Assessment (LCA) method for assessing the environmental impacts of electric vehicles (EVs), there are
few information regarding the environmental impacts connected to the life cycle of the charging infrastructures to operate the EVs, and, in particular, regarding the environmental performance of charging station for e-bicycles This study aims to evaluate, through the application of the LCA method, the environmental burdens of a stand-alone charging station for electric bicycles manufactured in Italy, assuming its installation and utilisation in Italy with a lifetime of 15 years. The investigated station is composed of eight designated positions for charging the e-bicycles’ battery and of two wind-solar modular systems that are respectively equipped with one photovoltaic (PV) module and three low profile axis wind turbines. The structure is also geared with a system connected to the conventional electricity grid which allows to provide energy when the wind and solar conditions are insufficient. The analysis also includes the whole life cycle of e-bicycles, as well as the potential avoided production of conventional electricity which may be replaced by the electricity surplus produced by the wind-solar system. The functional unit (FU) adopted to perform the analysis is one charging station installed in Italy and used for a lifetime of 15 years. System boundaries follows a cradle-to-grave approach and include four main phases: 1) production phase, 2) installation phase, 3) use and maintenance phase, and 4) end of life phase. The results demonstrate that the Climate Change impact related to the whole life cycle of the investigated charging station is 13,816.5 kg CO₂ eq per FU. The main environmental impacts are due to the production phase and, in particular, are connected to the production of the e-bicycles, while higher environmental benefits are connected to the replacement of conventional electricity with the energy surplus produced by the wind-solar modular system installed on the charging station.

625 Raw materials requirements scenarios for the electric mobility penetration in the Italian urban vehicle fleet: a life cycle thinking approach combined with raw materials assessment

L. Cutai, C. Chiacchierina, P. Porta, ENEA; M. La Monica, C. Scaglirino, CINFOG The automotive fleet is gradually changing from internal combustion to hybrid and electric engines. This is fostered by the European policies concerning the need of reduction in pollutant emissions and in the improving of urban air quality. Currently most of the analyses carried out focus on the comparison of the emissions related to the different typologies of cars and on the CO₂ emission cut generated by the substitution of electricity produced from renewable sources in the use phase of the car. The proposed approach wants to investigate the need of raw materials in future scenarios of electric technology penetration in the urban vehicle fleet. Focusing on the Italian urban vehicle situation and considering the current technology used for the electric batteries and the recharging systems, the study account for the raw materials needed for penetration scenarios of the electric mobility adopting a Life Cycle Thinking perspective. The authors have been beyond a mere quantification of the primary materials required for the progressive electrification of the urban fleet, evaluating the raw materials availability from a market perspective and defining the limiting factor among three basic material of the current electric technologies (lithium, graphite and manganese). Therefore this work, starting from an analysis of the material needed for different electric mobility penetration scenarios in the Italian urban fleet, wants to highlight the market dynamics especially for 3 primary materials widely required in the electric mobility focusing also on the possibility offered by a transition to a circular economy, investigating the green mining potential available for these materials both for their recovering in the same technology and in others fields.

626 Coupling dynamic carbon accounting and partial-equilibrium economic model for energy policy assessment

A. Albers, P. Collet, D. Lorne, IPFN / Economics & Technology Intelligence; A. Benoit, CIRED / UPR BioWooELSA research group; A. Hélias, Montpellier SupAgro / LBE ELSA Energy production and consumption is the main driver for anthropogenic GHG emissions, and in the French context, the transportation sector is the principal emitter accounting for almost one third of these emissions. The growing need to reduce GHG emissions and mitigate climate change demands tapping alternative energy resources, as differently enforced by energy policies (e.g. the French Transition Plan for Growth Act). LCA scholars increasingly assess the environmental performance of the advance biofuels, but mainly from a static perspective. Results are therefore limited to linear simplifications, whereby long-term impacts might be neglected or underestimated. New dynamic LCA approaches have been suggested, however no consensus is available on how to treat Climate Change impacts. This study focuses on the temporal shortcomings of bioenergy systems while considering future outlooks and consequences on the market dynamics. The approach consists of a hybrid-approach combining the MIRET energy systems model with dynamic Chio accounting models towards dynamic LCA. The former—a proactive techno-economic partial-equilibrium model covering the French energy-transport sector—represents scenario-dependent outputs over a long timeframes (2007 to 2050), exploring optimisation options under no-policy and policy-driven constraints. The latter assesses biomass growth and allometric relations representing the Chio fixation of a vegetation species per hectare on an annual basis, and thus the time-dynamic Chio flows between the atmosphere and the biosphere. The assessed Chio flows primarily originate from lignocellulosic biomass and their co-products generated from MIRET outputs under business as usual and normative scenarios. The transformed Chio inventories are then combined with both dynamic and static LCA characterisation factors, towards a comparison of both approaches. The results show that the time factor is an essential component to properly assess long-term Chio sequestration potentials and climate benefits of lignocellulosic biofuels. The consideration of technological innovation and market dynamics in a transitioning energy system expands the assessment boundaries providing insights into least cost (economic optimisation) and low carbon (Chio sequestration) options influenced by policy and decision constraints. Future refinements addressing other bioenergy paths are envisaged.
samplers, the often used polar organic chemical integrative sampler (POCIS) and the recently introduced Speedis, POCIS and Speedis passive samplers were simultaneously deployed at sites likely to be contaminated with polar compounds, including agricultural greenhouse sites and wastewater treatment plant (WWTP) impacted locations. The extracts of the passive samplers were subjected to a battery of bioassays, specifically responsive to polar compounds, including ERu, anti-AR and GR chemical activated luciferase gene expression (CALUX) bioassays, as well as the RIKILT WaterSCAN for antibiotics activity. In addition, the Microtox test for non-specific toxicity to bacteria was run. The two investigated passive sampling devices generated a different toxicity profile in the applied bioassay battery, with several unique responses per passive sampler. Nonetheless, POCIS caused bioassay responses more frequently and more intensely, leading to more frequent trigger values exceeding the E-water value, and thereby to the detection of ecotoxicological risks. Hence, POCIS outperformed Speedis in most bioassays at the majority of the investigated locations. These results thus suggest that POCIS is best fit for application as passive sampling device targeting polar compounds in effect-based water quality monitoring strategies.

630 Endocrine modulation and toxic effects of sunscreen chemicals, Octocrylene and Benzophenone, on zebrafish Q. MENG, The Chinese University of Hong Kong; K. Chan, The Chinese University of Hong Kong / Life Sciences Sunscreen chemicals are used to prevent the skin and hair of human from the harm of ultraviolet light, and they are widely applied in a variety of personal care products. These materials are discharged to the environment continuously as daily care products. At present, many kinds of UV filters are found in surface water and polluted water, and their concentrations in the urine and blood of human are much higher than that in the environment, indicating that the UV filters have the possibility of bioaccumulation to cause toxic effects in the accumulated organisms. Benzophenone-3 (BP3), benzophenone-3-sulfone (BP3-SS), benzophenone-1 (BP1), benzophenone-8 (BP8) and octocrylene (OC) are four such chemicals that have been detected in environmental samples and linked to alterations in estrogen receptor signalling pathways and oxidative stress. In this study, zebrafish larva and a liver cell model of zebrafish liver cells, the ZFL cell line, will be used to investigate the potential risks of BPs and OC and the molecular mechanism underlying the toxic effects. Docking analyses, 24 h and 96 h chemical exposures will be conducted on the ZFL cells to determine the potential binding affinities to the estrogen receptor (ER) and the half-lethal concentration (LC50) for the UV filter chemicals. The gene expression profiles on the ER pathway and the aryl-hydrocarbon receptor (Ahr) pathway will also be measured by quantitative real-time PCR in ZFL and larvae exposed to the sunscreen chemicals. A dual-luciferase reporter gene system with AHR and ER clones transfected in ZFL cells will be used to confirm the biological activities of these sunscreen chemicals in ZFL cells.

631 Current status of in vitro bioassay approach in environmental risk assessment of endocrine bioactive environmental mixtures and individual organic contaminants M. Machala, Veterinary Research Institute / Chemistry and Toxicology; K. Pencíková, S. Strápáková, Veterinary Research Institute, Brno / Chemistry and Toxicology; L. Svrčková, Veterinary Research Institute, Brno / Chemistry and Toxicology; J. Neca, M. Ciganek, Veterinary Research Institute, Brno / Chemistry and Toxicology; I. Bartonková, Z. Dvořák, Faculty of Science, Palacký University, Olomouc; O. Koubková, J. Tonouchi, Experientia Mediciné, CAS, Prague; J. Vondráček, Institute of Biophysics, CAS, Brno Since 2001, our laboratory has continuously employed an ever growing set of in vitro bioassays combined with a detailed chromatographic analysis, and in some cases the effect-directed analysis, in order to identify principle modes of action of contaminants bound to river sediment, airbone or diesel exhaust particles. Toxicity profiling of selected individual contaminants was used as a complementary approach, which aimed to identify major toxic modes of action and principle contributors to specific toxicity effects. The AhR-mediated activity has been recognized to play a key role in toxicity of organic extracts of abiotic environmental mixtures. Using the DR-CALUX assay, we established relative effective potencies (REp) and low molecular weight (LMW) polyaromatic compounds, including PAHs, methyl-, nitro- and oxy-PAHs, thiophenes, dinaphthofuranas, benzoazinides and carbazoles, which complemented the available data on polychlorinated biphenyls, dibenzo-p-dioxins and dibenzofurans. Recently, we also developed REP values in human AhR-dependent reporter gene assay, in order to compare the potencies in rodent and human models. Using a set of various CALUX assays, responses were selected using a directed analysis by the transformation products, many EDCs are currently unknown. Therefore, characterization of the presence and identification of EDCs in wastewater are major issues in order to assess their occurrence in natural waters and the associated risks for wildlife. To date, in vitro assays based on luciferase reporter gene expression, are available to assess the biological activities of samples in a quantitative, sensitive, specific and fast way. The comparison of concentrations derived from bioassays and from chemical analyses allows assessing the contribution of micropollutants to the overall biological or toxic activity of a sample. In this study, a systematic approach combining effect-directed analysis (EDA) and high resolution spectrometry was applied to several urban WWTPs to establish an overall contamination diagnostic and to identify major contaminant that could be released in environment. For this purpose, crude extract from influent and effluent of an urban WWTP were analyzed by LC-QTOF and tested on estrogen, androgens and glucocorticoid receptors. The non-target screening allowed detecting more than 7000 and 4000 signals in influent and effluent extracts of WWTP, respectively. We observed that 70% of compounds detected in effluents were not introduced by the treatment process suggesting the formation of transformation products. Concerning the strategy implemented to identify compounds of interest, it was decided to use effect-directed analyses methodology to have a tool to target active compounds in relation with selected biological activity. To this end, the crude extracts were fractionated by HPLC and biologically active fractions were isolated for further chemical identification. Biological fractionation profile of samples indicated the presence of estrogenic and glucocorticoid activities at all studied sites with very similar fractionation patterns between sites, highlighting major and recurrent individual fractions. The identification of active compounds was performed using LC-QTOF and several drugs and their transformation
products (e.g. O-desmethyl venlafaxine, O-desmethyl tramadol) were recurrent found. This approach combined to LC-QTOF has allowed establishing a list of systematic detected non-target compounds in several wastewaters.

**Indigeneity and Science: A collaborative work in progress**

634 The Nechako White Sturgeon Recovery Initiative: A discussion of species at risk conservation, scientific outreach, community and First Nations support T. Lane, University of Saskatchewan; C. Williamson, Freshwater Fisheries Society of British Columbia; K. Amarawansha, University of Saskatchewan / Toxicology Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

Nechako white sturgeon (*Acipenser transmontanus*) is a genetically unique population of fish which have inhabited the Nechako watershed for roughly 10,000 years. Within the last 50 years this population has suffered significantly because of anthropogenic activities such as the Construction of Riverbed Filtered Water in Canada identified the Nechako white sturgeon as a Nationally Significant Population. In 2006, this population was further listed as endangered under the Species at Risk Act. Prior to both designations in 2000, the Nechako White Sturgeon Recovery Initiative (NWSRI) was established in Vanderhoof, British Columbia. The goal of the initiative is the conservation and recovery of this one-of-a-kind population of white sturgeon which hold intangible cultural value within communities surrounding the Nechako watershed. A 5-million-dollar aquaculture facility, the Nechako White Sturgeon Conservation Centre was designed specifically for the NWSRI, built, and opened in 2014 to provide the resources to further support this conservation effort. This facility was a product of over a decade of work by a Technical Working Group (TWG) and a Community Working Group (CWG). The TWG includes biologists, industry and First Nations members who have a vast knowledge of white sturgeon. The goal of the TWG is to use the best available science, local and traditional knowledge to determine why the Nechako white sturgeon population is declining and to develop a plan to rehabilitate this population of fishes. The CWG is composed of First Nations members, local and regional governments, industry, and public volunteer. The CWG plays a vital role in communication, public outreach, and promoting community involvement.

Activities of TWG and CWG support the mandate of the NWSRI through direct involvement of First Nation communities, volunteers, and students. The Emergency Sturgeon Live Release Boat Kit program is an example of multiple First Nation communities working in union with the NWSRI to promote conservation and stewardship of Nechako white sturgeon. The annual Juvenile Sturgeon Release event involves students, volunteers and First Nations who release thousands of juvenile sturgeons, which were reared from eggs by the TWG, back into the Nechako watershed. The NWSRI is a unique conservation effort that promotes and utilizes the support of scientists, First Nations, volunteers and students to engage the community in the conservation of an endangered species.

635 The NSERC CREATE H2O Program on First Nations Water and Sanitation Security: Case Studies on Drinking Water Quality A. Farenhorst, University of Manitoba / Soil Science; W. Ross, University of Manitoba / Centre for Human Rights Research; R. Patidar, University of Manitoba / Department of Soil Science; R. Patidar, University of Manitoba / Department of Microbiology; G. Amaraswanya, K. Anderson, University of Manitoba / Department of Soil Science; E. Khafipour, University of Manitoba / Department of Animal Science; A. Kumar, University of Manitoba / Department of Microbiology

The NSERC CREATE H2O program is the first science-engineering research training program in Canada that combines technical water and wastewater management training with Indigenous theory, law and methodological skills training. Since its inaugural year in 2013, the program has trained 86 students who have collectively worked with 30 First Nations communities in the provinces of Manitoba, Ontario and Saskatchewan, Canada. 33% of the university students and postdocs enrolled in the program self-identify as Indigenous. This presentation provides an overview of the approaches the program is using for: engaging communities and students in research training activities, Indigenousizing science and engineering curricula, and designing advocacy strategies to support clean drinking water as a human right in First Nations communities in Canada. Case studies are presented to demonstrate the community-based monitoring programs implemented to examine drinking water quality in First Nations homes. First Nations communities participating in the research had various types of water distribution systems. Overall, water samples were collected from: lakes and groundwater (source water); water treatment plants, water trucks and community standpipes; homes relying on piped water, wells, above-ground cisterns and underground cisterns; and buckets/drums in homes without running water. Water analysis included standard measures of chemical and bacterial parameters, DNA and RNA techniques for microbial profiling, and the quantification of antibiotic-resistance genes in water samples. The main findings are that despite effective water treatment plants in communities, the tap water in many First Nations homes contained fecal bacteria at alarmingly high levels and antibiotic-resistance genes were also detected in a range of drinking water samples. The issue of poor drinking water quality in First Nations communities in Canada remains unsolved and there is an urgent need for improved monitoring and upgrading of infrastructure, especially in communities relying heavily on cisterns and community standpipes for drinking water supplies. Most importantly, investments to connect homes directly to water treatment plants via improved pipelines is key to reducing human exposure to waterborne illnesses, while enhancing options for families to participate in economic development, food security and spiritual and cultural wellbeing in their communities.

636 Rare earth elements (REEs) in the Canadian Subarctic: scientific perspectives and community engagement with environmental monitoring in Nunavik, Northern Quebec G. Gobbi, G. Millan, Centre détes nordiques, Université de Montréal / Department of Biological Sciences; J. Gérin-Lajoie, Université du Québec à Trois-Rivières / Centre détes nordiques, Département des sciences de lenvironnement; J. Chetelat, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health; E. Hébert-Houle, Université du Québec à Trois-Rivières / Département des sciences de lenvironnement; J. Rodwell, University of Montreal / Department of Chemistry; J. Heath, The Arctic Elders Society; H. Snowball, The Nunavik Village of Kangiqsualujjuaq; R. Mickpegak, Sakkuq Landholding Corporation Kuujjuaarak; M. Amyot, Universite de Montreal / Département de sciences biologiques

Many communities in Canada’s North are increasingly concerned about the impacts of large-scale socio-environmental changes, such as climate change and inseccies important on both bio and eco levels. One community for Indigenous knowledge is the environmental impact of mining, including the large number of rare earth element mining projects that are currently being developed in northern Canada. Rare earth elements (REEs) are a chemically-similar group of contaminants of emerging concern, which includes the 15 trivalent lanthanide metals. Not particularly rare, REEs are increasingly exploited for essential uses in high-tech industries, including electronics, clean energy, and agriculture. Although knowledge of the fate of REEs and their impact on natural ecosystems is critically needed as emissions increase, few ecotoxicological studies exist for REEs particularly field studies on their bioaccumulation and food web dynamics. To investigate how REEs behave in remote northern food webs, samples were collected from community-driven collaborative research projects with the Inuit communities of Kuujjuarapik-Whapmagoostui (K-W) and Kangiqsualujjuaq in Nunavik (Northern Québec). The combined objectives of these projects were a) to study the behaviour of REEs in northern ecosystems before the start of mining activities and b) to engage community members in the research process through the co-development of objectives, sample collection and the sharing of research results. We present perspectives from the perspective of community engagement: Can we detect REEs in freshwater, marine and terrestrial plants and animals? Do REEs bioaccumulate and bioamplify in northern food webs? How to best establish a sustainable community-based environmental monitoring program? Can we engage the youth in environmental monitoring and science education? Wildlife harvesting and tissue sampling was partly conducted by local hunters, including a range of key species important for both biomonitoring and country food. Indigenous knowledge was used in the study design, to coordinate local sampling, and to decide when, where and what species to collect. Our study presents novel data on the behaviour of REEs in northern ecosystems and recommendations for establishing sustainable and effective community-based environmental monitoring projects with indigenous communities for emerging contaminants.

637 Te Ohu Mō Papatūānuku: A Collective Response to Healing T. Godfrey, H. Hirere, Te Whare Whanga O Awanuiarangi / School of Undergraduate Studies

The use of pentachlorophenol (PCP) as an anti-sapstain in timber treatment, with subsequent disposal of chemically treated wood waste in the Whakatane District of New Zealand has resulted in a legacy of contamination. There are 36 identified wood waste sites located on private and public lands, as well as the customary lands and waters of the indigenous Ngati Awa people. The pervasive effects of contaminants upon both human and environmental health has led to the formation of collaborative groups from local government agencies, and industry. As a consequence of ongoing research, the use of a rather unique approach utilising combined myco- and phytoremediation to remediate dioxin-contaminated land has been adopted. Whilst implementation of the approach is underpinned by science, the use of “nature to heal nature” is an approach that resonates with the indigenous communities. Contemporary environmental problems resulting from anthropogenic activities often require the use of scientific based solutions. Hence, even when indigenous participation is encouraged by the scientific community as part of the problem solving process, the contribution of indigenous knowledge may be considered of less value than scientific knowledge. Of vital importance to ongoing environmental health however, is the role of indigenous knowing – indigenous relationships informed by binding and enduring familial links with lands, waters, and people. This presentation builds upon previous presentations detailing the journey of the Te Ohu Mo Papatuanuku research collaboration – using a synchronistic approach –
byrarchy science is an integral remedial component and provides a vehicle for remediation to occur, but cultural and soul connections of the indigenous people are the drivers of reciprocal remediation, and subsequent healing. Scientific knowledge applies science and indigenous knowing revitalises relationships, informing and infusing behaviour with an ethos of respect, empathy, and reciprocity.

638 Discussing the Unfamiliar but Contentious: Hydraulic Fracturing Consultation with Remote, Indigenous Communities in the Northern Territory, Australia R. Smith, Hydrobiology Pty Ltd; R. Pepper, Land and Environment Court of New South Wales; D. Ritchie, Niriti ONE Foundation On 29 September 2016 the Northern Territory (NT) Government announced a scientific inquiry into hydraulic fracturing of onshore unconventional reservoirs in the Northern Territory (the Inquiry) under the Inquiries Act (NT). The Inquiry was required to assess the available scientific evidence to determine the likely nature and extent of the environmental impacts and risks, including cumulative impacts and risks, associated with hydraulic fracturing of unconventional reservoirs and the Associated Activities in the NT. The Inquiry was specifically instructed to assess whether or not there would be unacceptable impacts or risks to economic, cultural and social conditions, by developing and implementing a stakeholder engagement program. Indigenous people make up most of the resident populations in the areas of the shale-gas basins in the Northern Territory. Indigenous people are linked with their land (including waterbodies) by their ancient traditions and continue to use their land in accordance with those traditions. As a community, they must be able to maintain their cultural traditions relating to that land in order that their ownership rights continue to be recognised, from one generation to the next. Indigenous communities are therefore particularly vulnerable to degradation of the landscape and the natural systems it supports. Therefore, the Inquiry undertook focused stakeholder consultation with remote indigenous communities across the NT via rounds of visits in face-to-face discussions and forums and hearings. These could not be conducted in the same manner as larger community consultation, and featured language and background knowledge barriers that are not typical of even remote non-indigenous community consultation in Australia. A number of these issues, and how they were addressed are discussed. Although the timeframe allotted to the Inquiry was particularly challenging for indigenous community consultation, and hence the extent of engagement in the process varied greatly between communities, nonetheless the Inquiry did achieve substantial engagement with most. The community feedback gained thereby was a vital input into the Inquiry’s assessment of the potential cultural impacts of shale gas development in the NT.

639 Incorporating cultural values and perspectives of First Peoples’ (Aboriginal People) into water planning, science and environmental water management B.J. Moggridge, Institute for Applied Ecology, University of Canberra / Institute of Applied Ecology Australia is the oldest inhabited continent on Earth, yet is has been the traditional lands of its original inhabitants Australia’s First Peoples for thousands of generations. Protecting water landscapes (surface and ground water) has always been a high priority for survival in a dry landscape, and protecting water remains a cultural obligation. The challenge for First Peoples is to ensure their value and relationship with water is not diminished or excluded by modern day water planning and science or from the Native Title Water Management. First Peoples acquire the right wisdom and traditional science and knowledge and many indicate that their worldview is seeing water as inseparable from the land and the sky, bound by traditional lore and customs for its planning and science or relationship with water is not diminished or excluded by modern day water planning and science or from the Native Title Water Management. First Peoples make up most of the resident populations in the areas of the shale-gas basins in the Northern Territory. Protecting water landscapes (surface and ground water) has always been a high priority for survival in a dry landscape, and protecting water remains a cultural obligation. The challenge for First Peoples is to ensure their value and relationship with water is not diminished or excluded by modern day water planning and science or from the Native Title Water Management. 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Age-Based and Time Trends of Exposure Chemical Biomarkers in the US Population 1999-2014

V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; J. Colacino, University of Michigan / Department of Environmental Health Sciences; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Biology, University of Massachusetts; A. Collaborators, Department of Environmental Health Sciences; O. Jolliet, University of Michigan

When interpreting biomonitoring data, we are limited by the cross-sectional nature of biomonitoring data and incomplete longitudinal data. It is important to differentiate between the potential influence of temporal determinants on legacy exposure, versus current exposure that may be due to relevant consumer product usage. In addition, an overarching systematic approach to studying exposure for a broad set of chemicals is missing. We developed a method to evaluate and compare age-specific exposure trends for 229 chemicals in the US population. Chemical biomarker measurements and demographic traits were obtained from the National Health and Nutrition Examination Survey (NHANES) datasets for the years 1999-2014 (n = 74,942). We extracted the persistency of chemical biomarkers from 16 different classes of chemicals from databases, literature review, and Quantitative Structure Activity Relationships (QSAR) when needed. To compare differences in chemical biomarker concentrations across the age groups, we partitioned the distribution of each chemical biomarker by 12 different age groups, which were defined based on age-specific behaviors. To evaluate the influence of age on the chemical exposure biomarker concentrations, we performed a series of biomarkers that have attracted a great deal of interest. The principle of the biomarker approach is to analyze the organism’s responses to pollutant exposure. Therefore, the aims of the present study were to verify the suitability of biochemical responses of estuarine fish (Mugronogas furnieri), copepod (Acartia tonsa) and crabs (Callinectes sap) as bioindicators to evaluate the environmental quality assessment in tropical estuarine environments of northern Brazil. Thus, we evaluated biomarker of metal exposure as metallothionein-like have a human half-life longer than one year and a long time lapse between the ban/phase-out and sample collection, while chemicals reflective of current exposure are primarily due to the usage. We observed that different age trend groups are explained by the product types in which the chemical is used and are not driven by belonging to a chemical family. The current study has defined criteria necessary to differentiate legacy exposure chemicals from currently exposed chemicals. Integrating generalized linear models with comparison of chemical distributions by the age groups led to identifying an age pattern of concern for children.

643 Biomarkers for the assessment of water quality in tropical estuarine environments in northeast Brazil

M. Jorge, Universidade Federal Maranhão / UFMA / Oceanografia e Limnologia; A. Bianchini, Universidade Federal do Rio Grande - FURG / Instituto de Ciências Biológicas

In attempt to define and measure the effects of pollutants in the aquatic ecosystem, biomarkers have attracted a great deal of interest. The principle of the biomarker approach is to analyze the organism’s responses to pollutant exposure. Therefore, the aims of the present study were to verify the suitability of biochemical responses of estuarine fish (Mugronogas furnieri), copepod (Acartia tonsa) and crabs (Callinectes sap) as bioindicators to evaluate the environmental quality assessment in tropical estuarine environments of northeastern Brazil. Thus, we evaluated biomarker of metal exposure as metallothionein-like have a human half-life longer than one year and a long time lapse between the ban/phase-out and sample collection, while chemicals reflective of current exposure are primarily due to the usage. We observed that different age trend groups are explained by the product types in which the chemical is used and are not driven by belonging to a chemical family. The current study has defined criteria necessary to differentiate legacy exposure chemicals from currently exposed chemicals. Integrating generalized linear models with comparison of chemical distributions by the age groups led to identifying an age pattern of concern for children.

645 Using Paleoeceotoxicology to Assess the Toxicity of Lake Sediments Impacted by Legacy Gold Mining in Yellowknife, NT, Canada

C. Cheney, University of Ottawa / Biology; M.P. Potthier, J.R. Thienpon, University of Ottawa / Department of Biology; J.B. Korosi, York University / Department of Geography; L.E. Kimpe, University of Ottawa / Department of Biology; J.M. Blais, University of Ottawa / Ecology

Natural resource extraction has supported the development of Canada’s far north for many decades, but the legacy of these extraction processes remains apparent in northern Canadian landscapes today. From 1948-2004 Giant Mine operated 5 km north of the City of Yellowknife, and contributed to the economic growth of one of Canada’s largest northern cities. Giant Mine roasted arsenopyrite ore at high temperatures to liberate gold, however a by-product of this roasting process was over 20000 tonnes of particulate arsenic trioxide, which was deposited to the surrounding landscape. Which fish species are most appropriate? Which age/class is the most appropriate? Which tissue should be chosen? Fish of which trophic level should be caught? In this contribution, influences of these factors on fish levels of PS (e.g., mercury, PFOS, HCB, HBCDD) will be evaluated. It will also be assessed whether the data allow deriving factors for the conversion of whole body to fillet monitoring data and vice versa. Another aspect is to test whether the normalization of biota monitoring data (e.g., lipid normalization, trophic level normalization) enhances comparability.

644 Monitoring of priority substances in German freshwater fish of different age, size and trophic level


Monitoring of chemicals in the frame of the WFD and the German Water Framework Directive (WFD) also requires the identification of certain priority substances (PS) in fish tissue. With the WFD daughter directive 2013/39/EU additional compounds were categorized as PS and for several of these environmental quality standards (EQSs) for biota have been introduced. This project was initiated to support the implementation of the WFD biota monitoring by comparative investigations and to provide alternative fish monitoring strategies. Using the WFD monitoring requirements (e.g., compliance testing for human health- and secondary poisoning of wildlife-based EQS, comparability of monitoring data between sites and trend monitoring). To this end a dedicated sampling campaign was designed which covered six different freshwater sites. Fish were caught at sampling sites in the rivers Weser, Havel, Elbe and Moselle, in Lake Starnberg and a lagoon at the Baltic Sea. At each site three of the fish species were sampled that are listed in a German guidance document (RAKON IV.3): bream, chub, perch, roach and whitefish. During each sampling campaign it was tried to obtain twenty fish per species from two different age classes allowing multiple comparisons. Fish were dissected into fillets and carcasses, which were processed separately. Biometric data (e.g. fish size, weight, sex) were documented. Age was determined by otolith readings, versus current exposure that may be due to relevant consumer product usage. In addition, an overarching systematic approach to studying exposure for a broad set of chemicals is missing. We developed a method to evaluate and compare age-specific exposure trends for 229 chemicals in the US population. Chemical biomarker measurements and demographic traits were obtained from the National Health and Nutrition Examination Survey (NHANES) datasets for the years 1999-2014 (n = 74,942). We extracted the persistency of chemical biomarkers from 16 different classes of chemicals from databases, literature review, and Quantitative Structure Activity Relationships (QSAR) when needed. To compare differences in chemical biomarker concentrations across the age groups, we partitioned the distribution of each chemical biomarker by 12 different age groups, which were defined based on age-specific behaviors. To evaluate the influence of age on the chemical exposure biomarker concentrations, we performed a series of biomarkers that have attracted a great deal of interest. The principle of the biomarker approach is to analyze the organism’s responses to pollutant exposure. Therefore, the aims of the present study were to verify the suitability of biochemical responses of estuarine fish (Mugronogas furnieri), copepod (Acartia tonsa) and crabs (Callinectes sap) as bioindicators to evaluate the environmental quality assessment in tropical estuarine environments of northern Brazil. Thus, we evaluated biomarker of metal exposure as metallothionein-like have a human half-life longer than one year and a long time lapse between the ban/phase-out and sample collection, while chemicals reflective of current exposure are primarily due to the usage. We observed that different age trend groups are explained by the product types in which the chemical is used and are not driven by belonging to a chemical family. The current study has defined criteria necessary to differentiate legacy exposure chemicals from currently exposed chemicals. Integrating generalized linear models with comparison of chemical distributions by the age groups led to identifying an age pattern of concern for children.

Ecotoxicology of micro and nanoparticles: Mechanistic
approaches to understand their risk for the environment and human health

646 Wastewater-based microplastics: Presence in wastewater effluent and effects on freshwater organisms
S. Ziajahromi, Griffith University / Smart Water Research Centre / Griffith School of Environment; P.A. Neale, Griffith University / School of Environment; A. Kumar, CSIRO / Center for Environmental Contaminants Research; L. Rintoul, Queensland University of Technology; F.D. Leusch, Griffith University / Australian Rivers Institute

Microplastic pollution has become a serious environmental concern. Microplastics associated with wastewater treatment plant (WWTP) effluent have been found globally in marine and freshwater environments. Nevertheless, the concentration of microplastics discharged via wastewater after different treatment processes remains less understood. In this study, we identified microplastics in the wastewater effluent from three major WWTPs utilizing primary, secondary and tertiary treatment processes in Sydney, Australia. A novel validated sampler was designed for in situ collection of microplastics from wastewater effluent. The sampling method was combined with an efficient sample processing procedure to enhance the accurate detection of microplastics. The results indicated that primary effluent contained an average 1.5 microplastics/L. The amount of microplastics reduced to 0.6 microplastics/L after secondary treatment and 0.2 microplastics/L after tertiary treatment. Polyester fibres and polyethylene beads were predominantly detected in wastewater effluent, which possibly originate from synthetic clothing and cosmetic products, respectively. This suggests that WWTPs can act as a significant pathway to release microplastics to the aquatic environment, given the large volume of treated wastewater being discharged on daily basis. The effects associated with wastewater-based microplastics (e.g. fibres and beads) were thus investigated by exposing two freshwater organisms, a waterflea (Cyclops dubius) and a sediment-dwelling midge larva (Chironomus tesserpi), to microplastics in water and sediment, respectively, at concentrations within the range of environmentally realistic concentrations. A dose-dependent effect was observed after acute and chronic exposure of C. dubius to microplastics, with fibres showing more significant effects, though chronic effects were only observed at concentrations six times higher than reported environmental levels. Further, exposure to an environmentally relevant concentration of microplastics adversely affected the survival, growth and emergence of C. tesserpi. Size-dependent effects were observed with microplastics, with beads in the size range of 10-27 µm showing more pronounced effects. Our study demonstrates that microplastics are released into the environment by WWTPs and can have effects on freshwater organisms at concentrations within an order of magnitude of environmentally relevant levels.

647 What is in our plastic? In vitro toxicity of extracts from plastic products
L. Zimmermann, Goethe University Frankfurt am Main; C. Volker, Institute for Social-Ecological Research; M. Wagner, Norwegian University of Science and Technology / Department of Biology

The ubiquitous abundance of plastic litter in aquatic ecosystems causes concern over their potential ecological and health impacts. So far, most toxicity studies focus on physical effects of plastic particles and chemical effects of sorbed environmental pollutants. The effects of chemicals intrinsically present in plastics, i.e. extraction products, are only poorly understood. Nevertheless, it is well established that these chemicals migrate from consumer products, thus representing a source of exposure to wildlife and humans. The aim of the current study is to investigate the in vitro toxicity of chemicals leaching from various plastic products and to characterize them using non-target chemical analysis. Different plastic types shall be ranked according to the toxicity of their leachates. Thirty-four plastic consumer products made of high-density polyethylene (HD/LDPE), polystyrene (PS), polypropylene (PP), polyethylene terephthalate (PET), polyvinyl chloride (PVC), polyurethane (PUR) or polyactic acid (PLA) were cut and extracted in a sonication-assisted, solvent-based procedure mimicking worst-case leaching. The extracts were tested for unspecific toxicity in the Microtox assay, for estrogenic and anti-androgenic activity in yeast-based reporter gene assays as well as for their potential to induce an oxidative stress response in the AREC32 assay. Two-thirds of the products leached chemicals triggering unspecific toxicity and one third of the samples induced an oxidative stress response. Nine plastic products released chemicals that were antiandrogenic and/or hormonally active and one third of the samples induced an oxidative stress response. This demonstrates that a substantial part of plastic products are a potential source of exposure to toxic chemicals.

648 Microplastic size-dependent toxicity, oxidative stress induction, and xenobiotic resistance (MXR) inhibition in the monogonont rotifer (Brachionus koreanus)
C. Jeong, J. Lee, Sungkyunkwan University

Plastic in marine ecosystems is of great concern in these days due to their world-wide distribution, persistence, and increasing amount of small-sized plastic particles due to degradation of larger plastic debris. However, little is known about their impacts on marine organisms, particularly at the molecular level. Here the dependence of microplastic toxicity to the monogonont rotifer (Brachionus koreanus) on particle size was investigated by studying the ingestion and egestion of different sized PS microbeads (0.05, 0.5, and 6 µm diameter). Exposure to polystyrene microbeads led to significant size-dependent negative effects on growth rate, reproduction, and lifespan. In consistent, transmission electron microscopy (TEM) analysis have revealed cellular damages in the rotifer B. koreanus exposed to 0.05 µm microbeads, indicating nano-sized microbeads would cause more serious impacts on aquatic organisms. To further explore the defense mechanism in response to different sizes of microbeads, the activities of several antioxidant-related enzymes and phosphorylation statuses of mitogen-activated protein kinases (MAPKs) were determined. Particularly, 0.05 µm microbeads have inhibited multixenobiotic resistance (MXR), resulting increase of sensitivity of rotifiers to environmental pollutants. Our study provides a better understanding of molecular responses in the rotifer B. koreanus in response to microplastics and their potential impacts on the aquatic ecosystem.

649 Sorption of model pollutants on microplastics and toxicity assessment using early life stage of zebrafish (Danio rerio)
B. Cormier, EPOC University of Bordeaux; M. Larsson, Orebro University / Marine Technology-Environment research centre (MTM); L.W. Yeung, University of Oregon / Department of Chemistry; C. Cléréndeu, EPOC University of Bordeaux; A. Karrman, Orebro University / MTM Research centre; B. Morin, University of Bordeaux / EPOC; M. Engwall, Orebro University / Man-Technology-Environment research centre (MTM); M. Bégout, X. Cousin, IFREMER / Laboratoire de Recherches Halieutiques de La Rochelle; J. Cachot, University of Bordeaux / EPOC; C. Keiter, Orebro University / MTM Research centre

The growing production of plastics increased the amount of plastic debris in aquatic ecosystems. Their degradation lead to the emission of microplastics (MPs) when their size is between 1-5000 µm. MPs can result from runoff and degradation (including photodegradation) or weathering of plastics, which increases their occurrence in sediments, industries and domestic sources. Virgin plastic polymers are, in principle, biologically inert and thus non-toxic. However, plastic production includes additives such as plasticizers, colorants or fire retardants that can be toxic. In addition to the potential toxicity caused by additives, MPs offer surfaces where hydrophobic pollutants can be adsorbed, including persistent organic pollutants (POPs). In marine environments, such chemicals are found at high concentrations in the surface layer, where low-density microplastics are most abundant. Indeed, these small particles can act as vectors and carriers for a wide range of pollutants and be ingested directly by organisms, causing chronic physical and/or toxicological effects. While accumulation of MPs in aquatic ecosystems is a growing concern in society, the toxicity of MPs for wildlife and the processes of sorption of organic pollutants onto MPs are very complex and poorly understood. Therefore, objectives of the present study were to investigate the sorption kinetics of two model pollutants to LDPE (Low Density PolyEthylene) microplastics for 3 months, and the toxicity linked to pollutants sorbed on microplastics, using zebrafish embryos and larvae. Results of the sorption experiment showed that a longer exposure time did not affect the sorption rate of PFOS, but affects BaP sorption to the particles. The sorption of BaP was increasing during the first 7 days, while for the remaining 3 months of the experiment, the concentration of BaP adsorbed by the MPs was constantly deacreased. On the toxicity aspects, no acute toxic effects were observed, using FET test with microplastics particles (virgin or spiked). No differences were found regarding sub-lethal endpoints (genotoxicity, phototoxicity, pyrene response (Pyr) and EROD activity) between the control group and fish exposed to virgin MPs, spiked MPs or comparison algae. Results showed that MPs can be vectors of pollutants which sorbed at the surface over time. The toxicity of MPs as carriers of POPs cannot be demonstrated with 96h of exposure to LDPE microparticles. Experiments are currently being done to test the toxicity of MPs.

650 Comparative role of microalgae and microplastics in the effects of chlorpyrifos on mussels
L. vidal-linan, Universidad de Vigo; B. Fernández, IEO; M. Albentosa, Instituto Español de Oceanografía / Centro Oceanográfico de Murtia; J. Bellas, IEO

Plastic particles within the microns range (microplastics, MP) are increasingly recognized as vectors and carriers for a wide range of pollutants, in marine environments. Microplastics/L after secondary treatment and 0.2 microplastics/L after tertiary treatment. Two forty-four plastic consumer products made of high/low-density polyethylene (HD/LDPE), polystyrene (PS), polypropylene (PP), polyethylene terephthalate (PET), polyvinyl chloride (PVC), polyurethane (PUR) or polyactic acid (PLA) were cut and extracted in a sonication-assisted, solvent-based procedure mimicking worst-case leaching. The extracts were tested for unspecific toxicity in the Microtox assay, for estrogenic and anti-androgenic activity in yeast-based reporter gene assays as well as for their potential to induce an oxidative stress response in the AREC32 assay. Two-thirds of the products leached chemicals triggering unspecific toxicity and one third of the samples induced an oxidative stress response. Nine plastic products released chemicals that were antiandrogenic and four slightly estrogenic. Overall, PVC and PUR extracts induced the highest toxicity in terms of potency and number of affected endpoints as almost all extracts triggered a high toxicity, oxidative stress and antiandrogenic activity. In contrast, PET extracts were less toxic with only one sample inducing oxidative stress. Interestingly, all PLA extracts produced a very high unspecific toxicity. Effects of HDPE, LDPE, PP and PS extracts strongly depended on the product. Our findings indicate that extracts of plastic products induce a range of toxicological endpoints, including unspecific toxicity, oxidative stress and endocrine activity. Sorption of organic pollutants to MP could contribute to these toxicological responses. This demonstrates that a substantial part of plastic products are a potential source of exposure to toxic chemicals.
Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (II)

652 Dissipation of the carcinogenic ptauquiloide in water resources
L. Rasmussen, Metropolitan University College; J.S. Wu, F. Clausen-Kaae, University of Copenhagen; J. Andersen, D. Lindqvist, Metropolitan University College; B.W. Strobel, University of Copenhagen / Plant and Environmental Sciences; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences

Ptauquiloide (PTA) is a natural carcinogen found in a number of ferns Worldwide. The distribution and occurrence of PTA is best known from the Bracken ferns (genus Pteridium) which are classified in Group 2B Possibly carcinogenic to humans by WHO/IARC. The content of PTA in Bracken is highly variable (up to 5 w-%). PTA is readily leached from Bracken stands from where it can enter the soil, waterways or potentially contaminate groundwater. Several records of PTA contamination of surface water and upper groundwater exist from Denmark and Great Britain. The fate of PTA in surface and ground water has not been studied. Under sterile conditions, dissipation (= hydrolysis) of PTA in aqueous solution follows classical first order kinetics: \[ k_{diss} = k_{abs} \cdot [H^+] + k_{alcal} \cdot 2\cdot[H^+] \cdot [HCO_3^-] \]. The rate constants are: \[ k_{abs} = 25.7 \pm 1.0 \cdot 10^{-5} \cdot h^{-1} \] \[ k_{alcal} = 9.5 \pm 6.0 \cdot 10^{-6} \cdot h^{-1} \] and \[ k_{alcal} = 4.8 \pm 6.0 \cdot 10^{-6} \cdot h^{-1} \]. The activation energy for PTA hydrolysis at pH 4.6 is approx. 75 kJ mol\(^{-1}\). Hence, hydrolysis is a function of both pH and temperature. The purpose of this investigation was to study the dissipation of PTA under near natural conditions using 10 different surface and groundwater samples from Denmark and compare to the degradation kinetics with the existing model for hydrolysis. Dissipation was fast in natural non-sterilised lake waters with half-lives from 5 to 25 h. All PTA were degraded within 200 h. Sterile controls had no degradation. Winter samples exhibited slower degradation (half-lives up to 100 h). Sterile samples followed the existing model for hydrolysis closely, i.e. no degradation at neutral pH. PTA persist considerably longer in groundwater. Half-lives in groundwater ranged from 7 to approx. 50 days with fastest degradation in alkaline waters. The existing model for hydrolysis could generally predict the rate of degradation in groundwater. However, the model did not perform well at low or high pH. Pterosin B was formed as the end product by hydrolysis in the tested groundwater at a molar ratio of approx. 1.1 for PTA:Pterosin B. However, under weak acid conditions, only approx. 10% of the potential pterosin B were formed. The risk of leaching from Bracken stands and contamination of surface waters is highest during the winter season. PTA has the potential of contaminating mainly shallow aquifers as the compound can persist for up to several months in contact with groundwater. The risk is expected to be highest at near-neutral conditions in aquifers.

653 On-line detection of algal toxins in sea water
S.F. Bodini, SYSTEA; F. Pasquazzi, Systea SpA; A. Porchetta, L. Micheli, G. Volpe, L. Fabiani, University of Tor Vergata; L. Sanfilippo, P. Moscetta, Systea SpA; G. Palleschi, University of Tor Vergata

Natural toxins produced by plants, algae and microorganisms represent a serious concern for public health. Current detection methods need expensive equipment, trained personnel and complicated protocols. In particular, the determination of marine biotoxins, released as a consequence of toxic algal blooms, is performed offline on fish/shellfish homogenates rather than on-line, resulting not appropriate for monitoring programs that require real-time warnings like in specific situations relevant for public health, such as bathing sites and aquaculture plants. Thus, there is a special need for on-line, continuous, rapid and sensitive field tests. To fill this need, a new on-line system was developed and the immunofluorescence Enzyme-Linked Immuno-Magnetic Capture Microplate assay for the detection of Domoic Acid, Sannotoxin and Okadaic Acid in seawater. The assay is based on the fact, that in the presence of the target toxin, competition occurs and consequently the color production decreases proportionally to the toxin concentration. This analytical approach allows to combine antibody selectivity, convenience of a separation step through the use of magnetic beads and simplicity of the detection reaction. Next, the magnetic assay was integrated within a fully automated PC-controlled on-line analyzer based on the micro Loop Flow Reactor technology able to host three immunoassay sub-modules. Specific volumes of reagents were injected to a flow cell, equipped with a heater, a magnet and an optical group. Because most of the reagents needed to be kept at 4°C, a Pelhier refrigerated compartment was designed and incorporated in the instrument. Laboratory measurements were executed to validate the prototype efficiency to detect sub-ppt concentrations of the algal toxins. The obtained calibration lines were consistent with the strict requirements limiting the presence of the toxins in environmental waters. On-line suitability was demonstrated by a field installation on a floating platform in the port of La Spezia, Italy, for daily monitoring of real marine water samples, in which the instrument was integrated together with the device for real-time data transmission. When first toxin outbreaks related to O. cf. ovata occurred in 2005 along the Ligurian coasts (Italy), little was known on several aspects of the phenomenon. Although some Ostreopsis spp. were known to produce congeners of palytoxin (PLTX), O. cf. ovata was not known as a toxic species and its metabolical profile had never been investigated. Secondly, although PLTX itself was reported as one of the most potent marine toxins known, it was not yet identified as the causative agent of fatal food poisonings in the tropics, it had never been suspected to exert toxicity through inhalation. Last but not least, the role of the environmental conditions on O. cf. ovata proliferation and toxin production had been poorly studied. Therefore, the need for increase knowledge on potential risks for humans and ecosystem stimulated research in the field. An Italian interdisciplinary network was created, including scientists from the Academia and operators of the regional environmental protection agencies and food safety laboratories. This joint effort led to clarify many of the aspects related to the Ostreopsis phenomenon that still represents one of the major threats to humans in the Mediterranean area. This presentation is meant to summarize the results of our studies on O. cf. ovata, highlighting inter- and intra-specific variability of the strains, structural and biological variability of the detected toxins and, in some cases, linking such differences to the risk that PLTX congeners pose to humans following inhalatory, dermal and oral exposure. Phylogenetic relationships among many isolates of Mediterranean O. cf. ovata were investigated as well as innovative molecular qPCR based assay was developed for monitoring activities. A general overview of the environmental conditions that favoured O. cf. ovata proliferation and toxin production will be also provided based on laboratory data and in field observations. The methodological approach, besides addressing many of the palytoxin-related issues, may serve as template for facing in due time any emerging toxin-related threat to humans.

654 A decade of chemical studies on Ostreopsis. What’s left?
C. Dell‘Aversano, University of Napoli Federico II, Department of Pharmacy / Pharmacy; L. Tartaglione, University of Napoli Federico II / Department of Pharmacy; M. Forino, University of Napoli Federico II Department of Pharmacy / Department of Pharmacy; E. Reina, University of Napoli Federico II Department of Pharmacy / Department of Pharmacy and Chemistry; C. Totti, S. Acconcia, University Politecnica delle Marche / Department of Life Science and Environment; R. Pistocchi, F. Guerini, L. Pezzolesi, Alma Mater Studium University of Bologna / Department of Biological, Geological and Environmental Sciences; G. Honsell, S. Segre, University of Udine / Department of Agricultural and Environmental Sciences; M. Perre, B. Sanna, University of Trieste; A. Tabaro, University of Trieste / Department of Life Sciences

Over the last decade massive blooms of the benthic dinoflagellate Ostreopsis cf. ovata, once confined to tropical and subtropical areas, have occurred in more temperate regions worldwide including the Mediterranean Sea. Concurrently, negative impacts on human health mainly due to inhalation of toxic aerosols and/or skin contact with explosive cell debris have been observed in some cases. In other cases, the causative agent of fatal food poisonings in the tropics, it had never been suspected to exert toxicity through inhalation. Last but not least, the role of the environmental conditions on O. cf. ovata proliferation and toxin production had been poorly studied. Therefore, the need for increase knowledge on potential risks for humans and ecosystem stimulated research in the field. An Italian interdisciplinary network was created, including scientists from the Academia and operators of the regional environmental protection agencies and food safety laboratories. This joint effort led to clarify many of the aspects related to the Ostreopsis phenomenon that still represents one of the major threats to humans in the Mediterranean area. This presentation is meant to summarize the results of our studies on O. cf. ovata, highlighting inter- and intra-specific variability of the strains, structural and biological variability of the detected toxins and, in some cases, linking such differences to the risk that PLTX congeners pose to humans following inhalatory, dermal and oral exposure. Phylogenetic relationships among many isolates of Mediterranean O. cf. ovata were investigated as well as innovative molecular qPCR based assay was developed for monitoring activities. A general overview of the environmental conditions that favoured O. cf. ovata proliferation and toxin production will be also provided based on laboratory data and in field observations. The methodological approach, besides addressing many of the palytoxin-related issues, may serve as template for facing in due time any emerging toxin-related threat to humans.
According to the General Food Law, the European Food Safety Authority (EFSA) is required to identify emerging risks in the fields within its mission. EFSA has developed a methodological framework for identification of emerging risk, starting from a preliminary identification of priority emerging issues through knowledge networking activities. The long term anticipation of emerging risks includes the identification of drivers. Drivers are the underlying natural or human-induced factors that directly or indirectly cause emerging risks. Climate change is recognised as a critical driver and its impact on the occurrence and toxicity producing phytoplankton, bacteria and pathogenic viruses and on other food safety domains was demonstrated. With the aim of further exploring tools to identify and prioritise emerging risks, EFSA initiated a project focusing on climate change as a driver of emerging risks for food and feed safety, including plant and animal health. A knowledge discussion group involving the major institutions involved with climate change has been created. The group will define criteria to identify relevant subdrivers (eg. rising and more fluctuating temperatures, changing precipitation patterns, increase in natural disasters etc), the issues relevant to different food safety domains including plant health and animal health, and to develop a harmonised and transparent scoring system applicable to the identified emerging issues in order to prioritise future research and risk assessment activities.

Advances in evaluating and regulating endocrine disruptors

658 Hazard identification of endocrine disrupting properties of pesticides on non-target organisms: state of the art and future perspectives

S. Vázquez, EFSA - European Food Safety Authority / Pesticides Unit; B. Horta, EFSA - European Food Safety Authority / Pesticides; D. Auteri, EFSA - European Food Safety Authority / Pesticides Unit

According to the Regulation (EU) no 283/2013, setting out the data requirements for active substances, in accordance with Regulation (EC) No 1107/2009 concerning the placing of plant protection products on the market, the endocrine disrupting properties of pesticides should always be assessed, as substance identified as an endocrine disruptor should not be approved. Most of the current knowledge about endocrine disruption is related to EATS (Estrogen, Androgen, Thyroid and Steroidogenesis) modalities in vertebrate organisms i.e. there is a good mechanistic understanding on how those modalities can lead to an adverse effects. The OECD conceptual framework and the OECD 150 provide an overview of the existing assays for the endocrine disruptors (ED) hazard identification and guidance on how to interpret the results of those tests. A suitable testing strategy which allows the risk identification and ED properties of pesticides through EATS modalities is available for some taxa of non-target organisms (i.e. fish and amphibians). The analysis confirmed that the available test methods and knowledge on birds’ endocrinology do not allow a full ED assessment although they can provide supportive information. In the case of reptiles, appropriate standard test methods are completely missing. In some circumstances, extrapolation between taxa could be scientifically supported. However, consideration should be given to taxon-specific differences. Extrapolation between mammals and amphibians regarding the ED hazard identification through the thyroidal modality has been investigated in the past. A similar analyses has not been done for EAS modalities, however, in some cases extrapolations among oviparous vertebrates is scientifically justified e.g. in the case of the steroidogenesis pathway leading to reproductive dysfunction (more specifically egg production). The main scope of this work is to present a critical overview of the available standardised test methodology for the ED assessment of non-target organisms, including consideration on the extrapolation between taxa. In addition, possible future perspective and research needs are discussed.

659 Contaminants of emerging concern in the North American Great Lakes: Evidence of reproductive disruption from field and laboratory studies

H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory; L. Thomas, St. Cloud State University / Biological Sciences; L. Wang, St. Cloud State University; V. Pipol, St. Cloud State University / Aquatic Toxicology Laboratory; Z. Jorgenson, St. Cloud State University / Environmental Contaminants; S. Elliott, U.S. Geological Survey / Minnesota Water Science Center; M.E. Brigham, U.S. Geological Survey

Analysis of nearly 500 surface water samples collected as part of the Great Lakes Restoration Initiative at 54 sites in tributaries of the North American Great Lakes Watershed confirmed the ubiquitous presence of Contaminants of Emerging Concerns (CECs) in anthropogenically impacted aquatic environments. Cluster analyses of commonly detected CECs in this data matrix suggests that the co-occurrence of approximately half of the CECs can be attributed to dichotomous urban or agricultural upstream land use. Mixtures found in watersheds with urban influences commonly contained steroid estrogens, BPA, alklyphones, pharmaceuticals and personal care products. Agricultural influenced sampling sites contained herbicides and pesticides in addition to BPA and alklyphones, but mostly lacked pharmaceuticals and personal care products. Almost 3,000 resident and caged sunfish (Lepomis spp.) were collected from 27 of the 54 sampling sites and analyzed for indicators of stress associated with CEC exposure. In the presence of high aqueous CEC concentrations, glucose concentrations spiked in sunfish
plasma and liver cells exhibited toxic stress response. Canonical correspondence analyses revealed that concurrent with indicators of toxic stress, biomarkers of reproductive potential declined. To further examine the population level consequences, fathead minnows (Pimephales promelas) were exposed in the laboratory for three generations to the empirically derived urban CEC mixture at three environmentally relevant concentrations. Mixtures at environmentally manipulated concentrations enhanced fecundity in the F2 and 3 generations, while higher mixture concentrations resulted in declining fecundity. Taken together, this integrated series of studies indicates that CECS in Great Lakes tributaries may impact fish population health and sustainability.

660 AOP-informed assessment of Endocrine Disruption in freshwater crustaceans
K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment; M. Cronin, Liverpool John Moores University; E. Etnesson, Norwegian School of Veterinary Science; L. Etnesson, The Arctic University of Norway; F. Falciani, University of Liverpool; T. Iuchi, YOKohama City University / Molecular Environmental Endocrinology; C. LaLone, U.S. EPA / Mid Continent Ecology Division; Y. Li, NIVA Norwegian Institute for Water Research; C. Matthews, Liverpool John Moores University / School of Pharmacy and Biomolecular Sciences; E. Perkins, US Army Corps of Engineers ERDC; T. Rundberget, Norwegian Institute for Water Research; B. Salbu, Norwegian University of Life Sciences; I. Sylte, The Arctic University of Norway / Department of Medical Biology; D. L. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory; N. Vinas, Mississippi State University / Engineer Research and Development Center; Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management.

A number of exogenous compounds have the potential to interfere with the endocrine system of animals and may perturb vital endocrine processes to a degree causing an adverse effect (outcome) on ecologically relevant endpoints such as growth, development and reproduction. These endocrine disrupting (ED) effects have been well characterised in aquatic vertebrates and mammals due to the availability of well-defined endocrine system and substantial research effort in the last decades, but knowledge on ED effects in a larger range of species are still poorly characterized. Lack of knowledge on ED effects in invertebrates is currently a major limiting factor to properly perform risk assessment of endocrine disrupting chemicals (EDCs) across taxa. The present project has focussed on developing Adverse Outcome Pathways (AOPs) for EDs in aquatic crustaceans, and applying these to assess the hazard and risk of ecologically relevant complex mixtures of pollutants. Although several ED mechanisms have been proposed to be of relevance for crustaceans, perturbations of endocrine processes related to chemical interactions with the edeysome receptor (eGR) and the Juvenile Hormone (methyl farnesoid) receptor (MR) have been identified in several crustacean species. The present paper focus on the application of AOPs to i) develop linkage between endocrine mechanisms and adverse outcomes, ii) identify knowledge gaps and inform testing strategies, iii) identify sensitive species/taxa, iv) identify likely define toxicity endpoints suitable for Integrated Approaches for Testing and Assessment, IATA, 5) identify potential EDCs and 6) practical implementation of AOP in regulatory assessment. Novel different exposure scenarios. Acknowledgement - Funding from RCN-221455 "Adverse Outcome Pathways for Endocrine Disruption in Daphnia magna, a conceptual approach for mechanistically-based Risk assessment (www.niva.no/edrisk)", RCN-268294 “Cumulative hazard and risk assessment of complex mixtures and multiple stressors (www.niva.no/mixrisk)” and EU-FP7 project SOLUTIONS (http://www.solutions-project.eu/project/).

661 Assessing impacts of place-based mixtures of emerging contaminants on endocrine activity and adverse outcome pathways: comparisons of different life stages
R. Klaper, University of Wisconsin-Milwaukee / School of Freshwater Sciences; J. Crago, Texas Tech University/TIEHH / Environmental Toxicology The Institute of Environmental and Human Health TIEHH
Emerging contaminants often appear as mixtures of differing concentrations across a landscape. Traditional toxicological assays as well as receptor binding assays that examine the impact of mixtures of chemicals may not adequately detect all EDC components and do not describe the collective impact of mixtures as there can be cross-talk among molecular pathways. Using place-based mixture concentrations of emerging contaminants in combination with multiple molecular initiating events from adverse outcome pathways can help to identify potential hotspots of potential environmental impact that cross multiple mechanisms of action. This talk will discuss the use of transcriptomics to modify the OECD fish embryo acute test (FET) and chronic exposures to juvenile and adults fish are being used to examine EDC pathway related disruption. Examples discussed will include several experiments using exposure mixtures representing those measured in several locations in Lake Michigan.

662 Interference of hepatotoxicity with endocrine activity in zebrafish (Danio rerio)
L.A. Baumann, University of Heidelberg / Aquatic Ecology and Toxicology; H. Holbeck, University of Southern Denmark / Biology; L. Wietje, BASF SE / Crop Protection; Ecotoxicology; H. Schmidt-Posthaus, University of Bern / Institute of Animal Pathology; H. Segner, University of Bern / Centre for Fish and Wildlife Health; T. Braumbeck, University of Heidelberg / Centre for Organismal Studies
Vitellogenin (VTG), a well-established biomarker for the diagnosis of endocrine activity in fish, is used in the OECD test guidelines 229, 230 and 234. A reduction of VTG production (mainly in males) and more androgenic or anti-estrogenic activity, whereas an increase of VTG (mainly in males) is associated with estrogenic activity. However, the synthesis of VTG may not only be modified by typical endocrine-related pathways, but also through non-endocrine-mediated processes. In particular, hepatotoxicity, i.e. toxicant-induced impairment of liver structure and function, can influence VTG as a biomarker, since it is synthesized in the liver. Changes in VTG caused by non-endocrine hepatotoxicity in a screening assay would unnecessarily trigger very labor-, animal- and cost-intensive higher tier testing (e.g. a fish life cycle test). Therefore, an intimate understanding of the interplay between primary endocrine-related and non-endocrine-related pathways influencing VTG production is crucial for the avoidance of false diagnoses. The present study is driven by the hypothesis that hepatotoxicity may interfere with VTG synthesis in the liver / exposed fish. Thus, we investigated the effects of two well-known hepatotoxicans, acetaminophen (APAP) andisoniazid (INZ), on zebrafish (Danio rerio) in a 21-day flow-through exposure test according to OECD guideline 230. Various hepatotoxicity- and endocrine system-related endpoints were recorded: - mRNA expression of different endocrine-related (vtg1, vtg3 and esr1) and hepatotoxicity-related marker genes (fabp10a, apoal, cyp2k19 and cyp3a65) in the liver; - hyaluronic acid (a biomarker for liver toxicity) levels in head/ tail homogenates; - liver histology and ultrastructure; Both APAP and INZ had different effects on exposed fish. While APAP did not cause any histopathological alterations in the liver, INZ significantly induced hepatocyte degeneration. VTG levels in APAP-exposed females were elevated, while no effect was observed in INZ-exposed fish. Likewise, other endocrine response in the liver differed between both compounds and indicate that both did interact with different endocrine- and hepatotoxicity-related pathways. The results from both studies will further be evaluated with respect to their potential for the development of an adverse outcome (AOAOP) for interference of hepatotoxicity with the VTG response in fish.

663 Single Pulse Exposure of Different Life Stages of Zebrafish to the Selective Estrogen Receptor Modulator Tamoxifen Citrate
The discussion about the regulation of endocrine disruptors (ED) is on-going between groups of scientists, authorities and stakeholders. Especially dose-dependency, low dose effects and effect thresholds are still under debate. To address parts of these questions, a static life-cycle test with zebrafish (D. rerio) has been performed to examine if a pulse exposure to an ED might lead to distinguishable effects and the establishment of a dose-response relationship is possible. The results will be used for a comparison with available data originating from a flow-through study with TC in zebrafish. A water-sediment system has been set up to exposed different life-stages (group A: 40 eggs, group B: 20 juveniles, group C: 16 adults) to a known ED, Tamoxifen citrate (TC). Observed endpoints included early-life stage growth, development and reproduction as well as adult growth, sex ratio, vitellogenin levels and F0-generation early life-stage. Four concentrations of TC were applied as a pulse in three replicates each, ranging from 125 µg/L to 1000 µg/L (spacing factor 2). Four controls replicates were included. Mortalities occurred in all developmental stages (groups A to C), especially in high concentrations (500 µg/L, 1000 µg/L). In sexually mature fish (group C) mortality was higher in males. A decline in fertility could be observed for group C, possibly related to the higher male mortality. Total egg numbers appeared unaffected. The results were mirrored for fish introduced as juveniles (group B): While fertility rates were not influenced negatively, fecundity was lower in remaining concentrations (125 µg/L, 250 µg/L). Changes in egg morphology were noticed shortly after exposure (groups B-C). Consequently, F1-fish showed a dose-dependent decrease in survival rates and growth. Although reproduction data are difficult to be attributed to endocrine activity, an influence on the endocrine system of the test animals seems apparent. Particularly sex specific effects in F0-fish as well as an impaired early life-stage in F1-fish are of highest interest. Further data on vitellogenin and reproduction will help clarifying pending questions. Additionally, several other accessible datasets from zebrafish studies featuring paired pulsed and flow-through exposures of EDs with diverse dissociation times will be integrated in the concluding assessment. The final objective is to deduce possible effect thresholds based on internal concentrations.

BIER is good for you: How biotransformation and elimination rate information can improve chemical assessments.
664 A Tiered Approach for Screening Chemicals for Biomagnification Potential in Humans
A. Sangion, University of Insibria / Department of Theoretical and Applied Sciences (DiSTA); J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; P. Gramatica, University of Insibria / Department of Theoretical and Applied Sciences (DiSTA)

Bioaccumulation is a process in which the chemical concentration in an organism exceeds the concentration in the respiratory medium, the diet or both and is an integral aspect of hazard and risk assessment. Strong correlations between partitioning properties such as the octanol-water partition coefficient (Kow) and the octanol-air partition coefficient (Koa) and the rate of water-respiring and air-breathing organisms have led to Kow and Koa being the primary screening criteria for bioaccumulation assessment. However, primary biotransformation rate constants (ka) and half-lives (HLa) are also critical determinants of bioaccumulation. Here we present a tiered approach for screening the bioaccumulation potential of organic chemicals in air-breathing organisms. The tiered approach progresses from screening-level conservative assumptions based on Kow and Koa only to more realistic assumptions for, internal distribution, chemical properties and biotransformation (Tiers from 1 to 4 respectively). Biomagnification Factor (BMF) derived from a typical human diet as calculated by the Risk Assessment Identiﬁcation And Ranking (RAIDAR) mode is the metric for assessing bioaccumulation potential in air-breathing organisms of approximately 13W. Nichols, U.S. EPA / GRD NHEERL Mid Continent Ecology Division; B. Wetmore, U.S. EPA / National Exposure Research Laboratory; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

665 Critical Evaluation of a Human In Vitro Biotransformation Rate Database: Case Study of Seven Chemicals
K.L. Foster, ARC Arnot Research and Consulting Inc. / Adjunct Professor, Trent University, Applications of Modelling & Quantitative Methods (AMOD); A. Looky, ARC Arnot Research and Consulting Inc.; J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; M. Embry, ILRI, I. Bremner, University of Guelph / Environmental Health and Safety; N. Zappala, University of Toronto - Scarborough / Dept. of Nutrition, Diet, and Environmental Health

The integration of mechanistic approaches in Environmental risk assessment, may reﬁne bioaccumulation predictions of bioaccumulation and trophic transfer. The removal of sediment or sediment components, such as associated siloxanes. Incorporating these processes into the bioaccumulation hazard assessment is relevant for aquatic ecosystems. The bioaccumulation of hydrophobic organic contaminants (HOCs) in sediment-dwelling organisms because: 1) HOCs often accumulate in sediments to concentrations greatly exceeding the concentration in the overlying water; and 2) a number of papers illustrate that sediment-associated HOCs are available for uptake in benthic organisms. Alternatively, benthic organisms may be able to metabolize organic contaminants (i.e., biotransformation), thus reducing their body burden. However, available information on the biotransformation capacity of benthic organisms is very limited. We conducted a number of experiments examining uptake and biotransformation of sediment-associated cyclic volatile methylsiloxanes (i.e., D4 and D5) in two deposit-feeding worms, namely, the estuarine polychaete, Capitella teleta and the freshwater oligochaete, Tubifex tubifex. This presentation will provide examples of how biotransformation capacity varies among the two benthic deposit feeders, and how biotransformation may reduce body burden and facilitate the removal of sediment-associated siloxanes. Including these factors in a hazard or risk assessment are likely to impact PBT assignment and categorization, and exclusion of benthic organism behavior may add model uncertainty to predictions of bioaccumulation and trophic transfer.

666 Sediment-associated cyclic volatile methylsiloxanes: Biotransformation in a freshwater oligochaete and an estuarine polychaete
H. Selek, Roskilde University / Dept Science and Environment; R. Windfeld, Roskilde University / ENSPAC

Chemical regulatory legislation of organic contaminants is generally based on an assessment of the chemical potential to persist (P) in the environment, bioaccumulate (B) in biota, and possess potential toxicity. Applying standardized exposure setups (i.e., water-only exposure) as historically has been employed in environmental risk assessment, may re ﬁne bioaccumulation data for hydrophobic organic contaminants (HOCs) in sediment-dwelling organisms: 1) HOCs often accumulate in sediments to concentrations greatly exceeding the concentration in the overlying water; and 2) a number of papers illustrate that sediment-associated HOCs are available for uptake in benthic organisms. Alternatively, benthic organisms may be able to metabolize organic contaminants (i.e., biotransformation), thus reducing their body burden. However, available information on the biotransformation capacity of benthic organisms is very limited. We conducted a number of experiments examining uptake and biotransformation of sediment-associated cyclic volatile methylsiloxanes (i.e., D4 and D5) in two deposit-feeding worms, namely, the estuarine polychaete, Capitella teleta and the freshwater oligochaete, Tubifex tubifex. This presentation will provide examples of how biotransformation capacity varies among the two benthic deposit feeders, and how biotransformation may reduce body burden and facilitate the removal of sediment-associated siloxanes. Including these factors in a hazard or risk assessment are likely to impact PBT assignment and categorization, and exclusion of benthic organism behavior may add model uncertainty to predictions of bioaccumulation and trophic transfer.
assessment of single chemicals. (iii) Development of PBTK models for environmental risk assessment of multiple chemicals. Generic PBTK models for single compounds in rainbow trout (*Oncorhynchus mykiss*), fathead minnow (*Pimephales promelas*), stickleback (*Gasterosteus aculeatus*) and zebrafish (*Danio rerio*) have been developed. Physiological description and parameters proposed by Nichols et al. [1] were updated by an extensive literature search. New mathematical functions were proposed to integrate the main factors influencing the toxicokinetics (water temperature, growth dilution, reproduction cycle,…). Default values for compound-specific parameters were estimated by QSAR models based on hydrophobicity [2, 3]. An optional interaction terms was added to the mixture PBTK models for metabolic interactions such as competitive inhibition. Two case studies were selected based on availability of toxicokinetic (TK) and toxicodynamic (TD) data for single compounds and for mixtures. In the first case study, the interaction between melamine and cyanuric acid was studied and in a second case study, the interaction between chlorpyrifos and permethrin was modelled. The models developed enable to model interactions that are observed between exposure concentrations and final effects. The QSAR estimations of certain compound-specific parameters can compensate for the lack of data in fish. Extrapolation from one species to another with the various models developed can also help bridge gaps. [1] Nichols et al. 1990. Toxicol Appl Pharmacol 106:433-447. [2] Bertelsen et al. 1998.. Environ Toxicol Chem 17:1447-1455. [3] Nichols et al. 2006. Aquat Toxicol 78:74-90.

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**Application of Aqueous and Dietary In-Vivo Bioaccumulation Tests to Determine Biotransformation Rates, Elimination Rates and other Bioaccumulation Metrics**

F. Gobas, Simon Fraser University / Resource & Environmental Management; M. Dimauro, K. Compton, Simon Fraser University; Y. Lee, Simon Fraser University / Resource and Environmental Management; V. Otton, Simon Fraser University / Resource and Env Management; J.C. Lo, Simon Fraser University / Biological Sciences; G. Allard, Simon Fraser University / Faculty of Environment

Bioaccumulation assessment is quickly evolving to respond to the need to conduct bioaccumulation assessment faster, better, cheaper while reducing animal use. In this presentation, we present novel methods for conducting both aqueous and dietary bioaccumulation tests that provide more information on bioaccumulation than currently used methods while also reducing animal use, effort and costs. Stream-lined aqueous bioconcentration test designs and dietary bioaccumulation studies following OECD 305 test guidelines are shown and discussed. A key element of the novel methods is the use of reference chemicals. In addition to experimental methods, we also present computational methods for deriving biotransformation rate constants, elimination rate constants and other bioaccumulation metrics with their associated error from the results of bioaccumulation tests. This involves an Excel worksheet, referred to as ADME calculator, that is specifically developed to interpret the results from aqueous and dietary bioaccumulation tests in terms of Absorption, Distribution, Metabolism and Excretion (ADME) rates including somatic and intestinal biotransformation rate constants, elimination rate constants, BCF and other bioaccumulation metrics. We further demonstrate that the application of reference chemicals can help to develop a full mass balance of the internal distribution of test chemicals in fish in the test and in the field under environment-specific exposure conditions. The application of the test results for determining exposure pathways of the test chemical under field conditions is illustrated. We conclude that bioaccumulation tests can become more effective in developing bioaccumulation profiles of chemicals when including reference chemicals.
Advances in environmental risk assessment of oil spills and offshore oil & gas operations (P)

M0001
An in situ amphibian metamorphosis assay to evaluate oil spill-related toxicity in receiving freshwater systems

R. Krohn, University of Calgary / Dept. of Ecosystem & Public Health, Faculty of Veterinary Medicine; J. Muscatello, Lorax Environmental Services Ltd; J. Smits, University of Calgary / Ecosystem & Public Health Faculty of Veterinary Medicine Divided dibutylmethyl (dbm) transported from the oil sands in northern Alberta, consists of a mixture of chemicals, such as aromatic hydrocarbons, metals and other compounds, which may pose risks to wildlife and human health, if spilled into the environment. There is a major knowledge gap regarding remediation of oil spills into freshwater ecosystems. The relative efficacy of different remediation strategies for these spill emergencies are untested. We have established in situ amphibian assay to serve as an indicator of health and recovery in freshwater ecosystems, which can be applied to assess risk and remediation efficacy. In spring 2017, Wood frog tadpoles were placed in 5, partially submerged cages (50 animals/cage), which were tethered to the peat-organic shoreline of Lake 260 of the International Institute for Sustainable Development-Experimental Lakes Area (IISD-ELA), Ontario, Canada. Tadpoles were fed and monitored every other day and were euthanized when >50% reached their metamorphic climax (the day of forelimb emergence), to perform gross anatomical examinations, sample collection and relevant biochemical analyses. Major outcomes: 1. Time to metamorphosis (an established, sensitive biomarker) 2. Mortality rate 3. Morphometrics (total body mass, length and hepatic mass) Analyses: 1. Hepatic detoxification effort (ethoxyresorufin-O-deethylase (EROD) enzyme activity); 2. Thyroid hormones level (sensitive biomarkers of endocrine disruptors); 3. Triglyceride levels (reflecting body condition & energy stores). 4. Tissue contaminant levels (metals, PAHs) Baseline data for Wood frog development in Lake #260 were acquired in 2017, and potential pitfalls and solutions for the metamorphosis assay were identified. This assay will be used in the 2018 field season with the experimental shoreline dibutylmethyl remediation strategies planned at Lake #260 at the IISS-ELA. In keywords: oil spill, endocrine disruptors, metamorphosis, Wood frogs

M0002
APPLICABILITY OF RISK BASED, TIERED ASSESSMENT OF PRODUCED WATER DISCHARGE IN NIGERIAN SHALLOW OFFSHORE ENVIRONMENT

M.G. Smit, Shell International; O. Anako, SPDC Nigeria Ltd

The pursuit of excellence in managing risks associated with produced water discharges has led to continuous innovation of internationally acceptable risks assessment tools for determining the risks associated with produced water discharges. This study utilized a structured hazard assessment framework for the assessment of potential risks from water discharges. At the centre of this structure is a comparative analysis of predicted environmental concentrations (PECs) of chemicals and effluents to predicted no effect concentrations (PNECs) of environmental receptors. However, the determination of the likelihood and severity of effects is complicated and based on an integrated evaluation of several Lines of Evidence (LoEs). This study utilized risk-based assessment tools from Shell’s tiered assessment framework for discharges. This framework was developed based on international good practice and includes screening tools that allow for a rapid tiered assessment of potential water discharge sources. The objective is to determine the applicability of risk-based practice to the specific shallow offshore discharge, with possible replication to other shallow offshore or near shore discharges in Nigeria. It also assessed if discharges would be acceptable from an international perspective and whether indeed the risks are tolerable and as low as reasonably practicable (ALARP). Results of the assessment indicate that oil in water levels at or below 25mg/L there is low concern related to the environmental risk of the hydrocarbons in the PW discharge. Phenols and BTX came up as the highest risk contributors but Tier-2 modelling indicated that these substances quickly dissipate after discharge. PETROTOX modelling showed that the hydrocarbon fraction in the PW could not fully explain the observed PW toxicity. This led to a recommendation for qualification and registration of offshore chemicals and identified a need for the alignment considerations of future Biological Monitoring programs to international protocols such as OECD and ISO. Application of smart screening tools (Tier-1) for frequent PBT monitoring to address variability and for tuning and focusing the larger Tier-2 and 3 assessments.

M0003
Assessment of the biological impact of using chemical dispersants to remediate oil spills in different environmental conditions using zebrafish embryos


Oil spills are a global concern due to their capacity to affect wide areas of the ocean and coastal environments of the subsequent restoration of the ecosystem. Early life stages of fish are especially sensitive to oil spills as they are unable to flee the area and lack mature detoxification systems to withstand the chemicals. They also represent a direct link to population consequences and resilience. The addition of chemical dispersants can facilitate the dissolution of some chemicals present in the oil and make them more bioavailable. In addition, some chemical dispersants have been proven to be toxic chemicals. The impact of crude oil on a specific ecosystem and its recovery potential are determined by the biotic and abiotic elements of the ecosystem such as species composition, temperature, oxygen level and salinity. At low temperatures the persistence of hydrocarbons in the environment increases. Based on the standard OECD test with zebrafish embryos, we have tested the toxicity of the chemical dispersant FINOSOL OSR52 and of the water accommodated fraction of a naphtenic North Sea crude oil produced with dispersant (WAF(OIL+D)) or without dispersant (WAF(OIL)) at different conditions of temperature and salinity. For WAF produced in marine water, polydimethylsiloxane (PDMS) sheets were incubated in the WAF(OIL)/WAF(OIL+D) and then used as passive dossers. Exposure to the dispersant caused 100% of mortality at concentrations ≥50 mg/L. Increased prevalence of malformations were observed at concentrations of 100 mg/L and WAF(OIL+D) resulted in a greater embryo mortality than the exposure through PDMS sheets. Significant differences were observed in hatching rate and in the prevalence of malformations of embryos exposed to WAF(OIL+D) in general greater survival rates were observed in embryos exposed to WAF(OIL+D) than to WAF(OIL). Zebrafish embryos appeared as a good model to study the toxicity of WAF depending on the temperature and on the addition of chemical dispersants. Funded by the EU H2020-BG-2005-2 project GRACE (grant agreement #679266), Spanish MINECO (NACE project CTM2016-81130-R) and MECED (FP7 grant to A.E.), the Basque Government (consolidated research group IT810-13) and the University of the Basque Country (UIF 11/37).

M0004
Behaviour and effects of a marine diesel oil in a semi-static exposure experiment using mussels (Mytilus spp.) from the Baltic Sea

R. Krohn, Finn & Environmental Institute, SYKE / OIL Research Centre; A. Ahvo, Finnik Environment Institute / Marine Research Centre; H. Kankaanpää, A. Reunamo, K.K. Lehtonen, K.S. Jorgensen, Finnish Environmental Institute / Marine Research Centre

Marine diesel oil is produced and transported in large volumes in the Gulf of Finland and also used extensively as fuel in marine traffic in the Baltic Sea area. The heavily intensifying marine traffic in the area increases the occurrence of smaller spills and leads to higher risk of major oil spills, which would certainly have drastic consequences to the local ecosystem. Chemical composition, mainly the polyaromatic hydrocarbons (PAHs), can be more variable between the different diesel fuels, affecting the toxicity of the diesel to exposed marine organisms. The aim of this study was to determine the changes in the concentration of different PAHs, accumulated in mussels, and a battery of biomarkers in Baltic Sea mussels (Mytilus spp.) exposed to a common type of low-sulfur marine diesel oil produced by Neste Oil’s Pervo refinery in Finland. The diesel oil was applied to mussel aquaria as a water accommodated fraction (WAF). The exposure setup consisted two replicate aquaria in each treatment; control, WAF-high and WAF-low, each with 200 mussels in 20 liters of artificial seawater (10°C). Water and WAF treatments were renewed every two days. Changes in PAH concentrations in water were constantly quantified using a TriOS Enviroflu HC-500 fluorometer sensor. Another sensor was used to collect auxiliary data on temperature, turbidity and chl a concentration. Biomarkers of oxidative stress, biotransformation, neurotoxicity and bioenergetics were measured from mussels at different exposure periods after a one week recovery period in clean water. Water and mussel tissue samples were also taken to chemical analysis of PAHs. Based on the sensor fluorescence data the initial PAH concentrations were ca. 30μg/L in WAF-high and 15μg/L in WAF-low treatments. In a semi-static system with mussels the concentrations decreased during 24h after which the level remained stable until the next water exchange. During the recovery period PAHs occurred in water after every water exchange, suggesting significant release of PAHs from mussels (both from shell surfaces and internal pools). Differences between the treatments were observed in various biomarkers measured. Combined fluorescence, chemical and biomarker data give important insights to the fate and toxic effects of marine diesel oil in the northern Baltic Sea environment.

M0005
Biliary PAHs and enzymatic biomarkers in the teleost Eucogres brasiliensis along four tropical estuaries in the Brazilian Northeast

J.S. Silva, R.N. Alves, UFPE
Universidade Federal de Pernambuco / Zoology;
Bioaccumulation of Sulfur and Nitrogen Containing Hydrocarbons in Petroleum Substances
T. Parkerton, ExxonMobil Biomedical Sciences Inc. / Toxicology & Environmental Science; A. Bleich, ExxonMobil Biomedical Sciences Inc; J. Butler, ExxonMobil Biomedical Sciences, Inc / Environmental Toxicology and Chemistry Laboratory; C. C. Sutherland, ExxonMobil Biomedical Sciences, Inc / Toxicology and Environmental Science; A.D. Redman, Exxon Mobil Biomedical Sciences / Toxicology and Environment Science Division; M. Lampi, ExxonMobil Biomedical Sciences.

A recent study aimed to characterize the composition of petroleum substances from different categories indicated that a variety of sulfur and nitrogen heterocyclic compounds were detected in the range of 10 μg/L to 1000 μg/L. These compounds were identified at different concentrations in the range of 10 μg/L to 1000 μg/L. The study results were used to calculate substance-specific lipid-normalized biomagnification factors, dietary assimilation efficiencies and growth-corrected eliminated rates. Comparison of experimental results to model predictions for non-metabolizable chemicals was used to infer the role of tissue and gut biotransformation in mitigating observed bioaccumulation. This study provides new data to inform bioaccumulation assessments of heterocyclic compounds and to support development of quantitative structure-property relationships for improved bioaccumulation prediction models of sulfur and nitrogen containing compounds.
Marine Biology and Biotechnology PIE/UPVEHU 
Biomarker approach has been widely used in mussel monitoring programs for several years. However, up to know it has not been commonly used in high latitude study areas. In order to establish reference values of cellular and tissue-level biomarkers in the Northern Atlantic Ocean, mussels of two sizes (small, 2-3 cm; large, 3.5-4.5 cm) from selected polluted (commercial harbor & ports, WWTP dumping area) and reference sites in Tromso (69° 40' N) and Trondheim (63° 26' N) were sampled in early autumn of 2016 and late summer 2017. Different tissue-level biomarkers including cell type composition (VvVAS) in digestive gland epithelium, structural changes of digestive alveoli (MLR/LET), relative proportion of digestive and connective tissue (CTD) and histopathological alterations in the digestive gland were measured. In addition, lipofuscin and neutral lipid accumulation (high MLR/LET values) and retraction of digestive diverticula resulting in apparently higher relative extent of interstitial connective tissue (high CTD values) were observed. Parasite burden, parasitic atresia, higher weighted prevalence values than in the reference site were recorded in the two polluted sites from Trondheim. Differences between the two mussel sizes were recorded in parasitic burden, large mussels exhibiting a higher level of parasitization than small mussels. Lipofuscin accumulation was higher and neutral lipid accumulation lower in the polluted sites than in reference sites in both study areas. Lipofuscin accumulation was present in hemocytes of Mytilus edulis in 23 samples from the polluted areas. Lipofuscin accumulation was observed consistently in abdominal and digestive gland hemocytes of mussel. In the digestive gland (including the digestive gland diverticula), lipofuscin accumulation was present in digestive gland diverticula and in the endo-lysosomal system (LSC) of digestive cells were also determined. Higher VvVAS values were recorded in polluted sites than in mussels from reference sites in both study areas. Moreover, mussels from impacted sites exhibited enhanced atrophy of the digestive alveoli (high MLR/LET values) and retraction of digestive diverticula resulting in apparently higher relative extent of interstitial connective tissue (high CTD values) were observed. These results appear to indicate that the dispersant in hemocytes of the marine mussel Mytilus edulis from the North Sea. The cell viability was assessed by trypan blue exclusion assay. The cell viability was assessed by trypan blue exclusion assay. The results suggest that relevance of temperature of WAF production on its cytotoxicity (produced at 10 and 15°C) and at 50 and 100% WAF (produced at 20°C). 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environment due to rainfall and surface runoff, and thus it may affect marine organisms. However, its toxicity and ecological risk to marine organisms remain largely unknown. Therefore, this study aims at investigating the environmental fate of larvicidal oil in the marine environment and its toxicities towards marine organisms at different trophic levels along the food chain. The composition of larvicidal oil was characterized by gas chromatography-mass spectrometry. It was found to consist mainly of aliphatic petroleum hydrocarbons (30-60%), followed by oxygen-containing polycyclic aromatic hydrocarbons (PAHs) (20%), and non-polar aliphatic hydrocarbons (15%). The concentrations of larvicidal oil were determined with the range from 6.92 mg/L to 53.89 mg/L, by analyzing water samples collected along coastal areas in Hong Kong. Standard acute toxicity tests were conducted to investigate their toxic effects to the marine macroalgae Isochrysa gaibuna and Chaetoceros gracilis (primary producers), the intertidal copepod Tigriopus japonicus (a primary consumer), the brine shrimp Artemia franciscana and fish embryos of the marine medaka Oryzias melastigma. Our results showed that although all test marine species were not very sensitive to larvicidal oil with the ranking of their acute median lethal concentrations (LC50) that were all above the estimated hazardous concentration for 5% of species (HC5), the results of a probabilistic risk assessment showed that the local marine ecosystem had 65.7% of chance to be at risk of oiling. The results of the NEBA, is often performed to achieve a Net Environmental Benefit Analysis, which is essential for environmental monitoring of tropical estuaries with ecologically important fish. In the Baltic Sea accidental oil spills are mainly combatted using mechanical methods. The results indicate that during the application of dispersants salinity plays a key role both for biodegradation and for dispersant on oil behavior. Therefore, the removal of the oils from the seaweed surface was considered as relatively fast (t1/2 = 3–4 days). Depending of oil type, the oil inhibited or stimulated photosynthetic activity. Marine diesel inhibited photosynthetic activity, whereas the three other oil types stimulated the activity. Thus, in general, the results indicated that oil smothering was relatively fast washed off in the sea water; 2) that, depending on the oil type, photosynthetic activity were stimulated or inhibited; and 3) that the photosynthetic activity was still affected (stimulated or inhibited) even after 14 days, although oil on water accommodated fraction (WAF) was exposed to the water accommodated fraction (WAF) and dispersed WAF (WAF-D) of napthenic North Sea crude oil in a semi-sea aquarium experiment. Concentration of WAF or WAF-D in the aquaria was 5%. The mussels were sampled after 0, 1, 7 and 21 days of exposure, and analyzed for accumulation of polycyclic aromatic hydrocarbons (PAHs), and biological effects including acetylcholinesterase, glutathione-S-transferase, catalase and glutathione reductase activities, lipid peroxidation, and protein carbonylation. In addition, changes in Mytilus-associated bacterial communities from the gills and digestive glands of the mussels were investigated by sequencing of 16S rRNA genes and quantitative PCR targeted to bacterial PAH-degradation genes. Water samples from the exposure aquaria were taken for oil and PAH analysis. Dispersant augmented the amount oil in the exposure water with 0.13 mg/L oil in 5.6 WAF-D compared to 44 mg/L oil in 5.6. WAF-D (GC-FID, petroleum hydrocarbons C16-C40). A significantly higher oil concentration was observed at the lower salinity WAF-D-W with 44 mg/L oil at 5.6 and 1.82 mg/L at 15. The higher salinity and WAF-D elicited more oxidative stress and neurotoxic effects already after one day of exposure. Mytilus-associated bacterial communities also varied depending on salinity and the use of dispersant. The results indicate that during the application of dispersants salinity plays a key role both for biodegradation and for the use of dispersant in the Baltic Sea. This study was taken into careful consideration when designing oil spill mitigation procedures in the Baltic Sea. The results of the experiments on the estuarine guppy Poecilia vivipara to monitor two integrated approaches using biological responses in multiple organization levels are essential for environmental monitoring of tropical estuaries with ecologically relevant tools. The guppy Poecilia vivipara, native species with a broad tropical distribution, was utilized in such an approach, using in situ field exposures in cages.
and keto compounds (Fraction III), while the saturated hydrocarbon were least represented (Fraction I). This trend is almost unchanged in samples from different microlocations at different depths. It can be concluded that composition of petroleum pollutants can be unchanged through the alluvial sediments up to 15m depth and they can reach the underground waters, consequently contaminating them (Fig. 2).  


determination of EROD and GST in these individuals. Resident fish at Bjes showed high EROD and GST induction that cannot be explained by PAHs contamination, and suggests the presence of other contaminants with mechanisms of action similar to dioxins, possibly from a paper industry. Elevation of GST activity was detected in three of the four sites assessed on both estuaries, and loss of swimming resistance was verified on individuals exposed at the same sites, indicating a correlation between GST and this behavioral effect relevant to survival of the species. Indications of acetylcholinesterase inhibitors were not detected, except at the BPES inner region. This study shows the potential and feasibility of using the guppy P. vivipara on the evaluation and monitoring of pollution in estuaries along the Brazilian coast.

MO019 NEW METHOD TO DETERMINE BTEX IN SOIL SAMPLES BY HPLC-DAD

L. Silva, Universidade Federal do ABC / PROGRAD - CLD; C. da Silva, E.C. Lima, UFABC / CCNH; D. Rosa, UFABC / CECS

Benzen, toluene, ethylbenzene and xylene, commonly referred as BTEX, are compounds of fossil fuel origin, and are relevant due to their high neurotoxic effects on humans, and potential effects on aquatic life and birds. Methods for the determination of BTEX, such as high performance liquid chromatography, are generally expensive and difficult to use with the concentration levels usually found in soil samples. This study proposes the use of high performance liquid chromatography coupled to diode array detection (HPLC-DAD) for the determination of BTEX in soil samples. A method was developed using as mobile phase methanol and H2O acidified with 250 μL of H3PO4 (70:30, v / v), Eclipse XDB C18 column (5μm x 4.6 x 250mm), flow of 1.5 μL min−1, λ = 205nm and T = 50 ° C. The analysis was carried out using the Agilent 1220 HPLC system equipped with an automatic injector, a column oven, and a diode array detector. Data were acquired using the OpenLAB DAD software. A calibration curve for BTEX standards was constructed in 7 concentration levels: 1 to 68 ppm for benzene, 1 to 80 ppm for toluene, 1 to 80 ethylbenzene and 1 to 85 for xylene. The curves were submitted to intra- and inter-assay repeatability analyzes. Standard curves with adjustments above 0.991 relative standard deviations (% RSD) of less than 1.9% were obtained. Reproducibility tests were performed with two solutions obtained from the standard solution. In the samples containing analytes from the soil contaminated with gasoline, % RSD was obtained below 6.5% and recovery rate was 68% for benzene and 75% for toluene, 78% for ethylbenzene and 78% for xylene. The method of soil analysis via HPLC is therefore efficient and as an alternative to be highlighted for analyzes of soils contaminated with gasoline. It is intended to validate the methodology using appropriate protocols and apply it in contaminated areas for the verification of BTEX levels in next steps.

MO020 Petroleum pollution of alluvial sediments near Sava river, Serbia

M. Ilic, IChFM / Department of Chemistry; S. Bulatovic, Faculty of Chemistry, University of Belgrade; T. Sovevic Knudsen, IChFM / Department of Chemistry; J. Milic, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; S. Miletic, J. Avdolovic, Institute of Chemistry, Technology & Metallurgy, University of Belgrade / Department of Chemistry; G. Devic, Institute of Chemistry, Technology and Metallurgy, University of Belgrade

Heavy oil "New Belgrad" is located on the left coast of the Sava River, about 1km from its estuary in the Danube, and represents a potential source of petroleum pollution of the alluvial area of Sava river. The aim of our research was to determine the presence of petroleum pollutants and their vertical migration in the alluvial area of Sava river. The investigation was started in the summer of 2015. The soil was sampled in three different microlocations (Z1, Z3 and Z4) up to depth of 15m. The sampled material was organized in the layers, and for all microlocations was made a lithological profile. Most of the samples have had a clayey-sand structure with low content of organic matter. Extraction of petroleum pollutants from soil samples were done using the Soxhlet apparatus with dichloromethane. After extraction, the dichloromethane extracts were then fractionated by column chromatography into fractions of: saturated hydrocarbons (Fraction I), aromatic hydrocarbons (Fraction II), and keto compounds (Fraction III) [1]. For monitoring changes in the vertical migration of petroleum pollutants, and the relationship of this migration with the soil characteristics, the group composition was determined for each borehole of all microlocations, taking into account their lithological profiles. Results of our research showed that in all samples the most represented were polycyclic aromatic hydrocarbons (Fraction III), while the saturated hydrocarbon were least represented (Fraction I). This trend is almost unchanged in samples from different microlocations at different depths. It can be concluded that composition of petroleum pollutants can be unchanged through the alluvial sediments up to 15m depth and they can reach the underground waters, consequently contaminating them (Fig. 2).
MO023
Risk-based assessment of produced water discharges - need for alignment
M.G. Smijt, Shell International
Produced formation water is the main waste stream from upstream oil and gas activities. For offshore installations, next to produced water re-injection (PWRI), discharge of treated produced water is a commonly used disposal route applied in line with ALARP principles (As Low As Reasonably Practicable), in order to properly manage treated water discharges, a variety of principles have been adopted in national and international regulatory frameworks focusing on e.g. the oil in water content, toxicity of produced water, PBT characteristics of applied offshore chemicals, environmental monitoring, etc. The onus is on the industry to comply with regulations in the country of operation, to properly manage the risk of produced water discharges and to relieve any concerns over the potential environmental effects in the receiving marine environment. For this purpose the industry is applying a diversity of tools and methods within the framework of risk-based assessment (RBA). Tools and methods range from simple (tier 1) screening tools to comprehensive (tier 3) field verification programs and include among others; chemical analysis, determination of PBT characteristics through whole effluent toxicity testing and modelling, dilution screening and 3D dispersion modelling, etc. Within those practices a wide range of risk endpoints are being applied, each with their own level of conservatism. Without harmonization of endpoints it is difficult to interpret when risks can considered to be adequately controlled. For example, different approaches base the assessment on either chronic or acute toxicity data. And where one method considers an acceptable mixing zone of 500m, the other might apply 100m (US-EPA). This hampers straightforward comparison of results of risk-based assessments across industry and regulatory frameworks. Different objectives of the assessment undertaken might, however, be a reason for existing differences in methods. It is, therefore, crucial that for each assessment method a corresponding assessment objective is formulated and communicated. This presentation will provide an overview of RBA practices commonly applied by the industry to offshore produced water disposal, showing main assumptions, input requirements, risk endpoints applied and corresponding assessment objectives. Examples will be used to highlight the need for further harmonization of approaches. Development of industry guidance including a common tiered framework for RBA is suggested as a first step to achieve this.

MO024
Spatial and temporal analysis of the risks posed by total petroleum hydrocarbon and trace element contaminants in coastal waters of Kuwait
E.E. Nicolaou, Cefas Lowestoft Laboratory / Environment and Ecosystems
Nine trace elements including As, Cd, Cu, Fe, Hg, Ni, Pb, V and Zn, and total petroleum hydrocarbons (TPH) were analysed by Gas Chromatography, after acid digestion of 23 stations of surface water, in coastal waters of Kuwait since 1984. The analysis was carried out using ICP-OES techniques. The results show that Cu, Cd and Cd had the most Kuwaiti AC breaches over time. Comparing the data of the last sampled year to the least stringent international AC, then Cu and Cd showed breaches at all stations. The tendency of Cu to show maximum significant TPH was monitored for Cd and Hg. No determinant measured showed a significant upward trend, indicating that water pollution for these contaminants is not a worsening situation. However, further sampling should be carried out to confirm these findings, especially at shoreline locations, where routine monitoring ceased in 2011 to investigate any recent changes.

MO025
Temperature-dependant toxicity of Naphthenic North Sea crude oil WAF, dispersant and their mixture: sea urchin bioassays
L.d. Miguel, University of the Basque country (UPV/EHU) / Department of Zoology and Animal Cell Biology; U. Izaguirre, University of the Basque country UPV/EHU / CBET Research Group Dept Zoology and Animal Cell Biology; Faculty of Science and Technology and Research Centre for Experimental Marine Biotechnology and Biotechnology P/E; I. Marigomez, Euskal Herriko Unibertsitatea / Zoology & Animal Cell Biology (Sci & Tech Fac)
Marine traffic and oil platforms in the North and Baltic Sea have been growing during the last years and the risk of spill oil is strongly correlated with these activities. Changes in water temperature could modify the potential toxicity of spill products including chemical dispersants. The impact of crude oil water accommodated fraction (WAF) and dispersants have been widely studied but their potential toxic effects at different given range of temperature have not been deeply yet explored, to our knowledge. Thus, as a part of a European project called GIBLUE the aim of the present work was to assess the potential toxicity of WAF produced from: Naphthenic North Sea crude oil (NNS), Finasol OSR52 dispersant (Total Fluids) and their mixture (NNS+Finasol OSR52) in a wide range of temperatures (5, 10, 15, 20 and 25°C). In order to identify temperature-dependant toxicity, acute toxicity bioassays using larvae and embryos of the sea urchin Paracentrotus lividus (Lamark) were performed. After the exposure period, EC_50 values were calculated, length of larvae was measured to assess the inhibition of larval growth. Additionally, larvae abnormalities were determined to calculate a general index of toxicity (IT). In the present study, at 25°C NNS WAF provoked a lower inhibition of larval length than the other studied temperatures. Accordingly, oil toxicity seems to be influenced by temperature. Indeed, temperature is known to affect hydrocarbon solubility and evaporation, and dispersant effectiveness. The same trend was found for Finasol OSR52 WAF. However, high temperature seems not to follow the same pattern in the case of the mixture. EC_50 and IT values were in accordance showing that dispersion increases WAF toxicity. Overall, results showed that temperature affects oil, oil:dispersant and chemical dispersant toxicity. In this study, larvae abnormalities and reduced larval growth indicate that toxicity was lower in crude oil WAF than in dispersant WAF, with their mixture in between, for all the temperatures tested. Acknowledgement – This work has been funded by the EU H2020-BG-2005-2 project GRACE (grant agreement number 679266), Spanish Ministry of Education, Culture and Sport (PhD fellowship L.D.M FPU15/05317 grant) and the Basque Government (Consolidated Research Group GIC IT810-13).

MO026
Temporal variability of acute toxicity of Produced Formation Water discharged from offshore platforms: the responses of sea bass (Dicentrarchus labrax L., 1758) larvae
L. Mariani, Cefas Lowestoft Laboratory / RSA; E. Magaletti, B. Di Lorenzo, F. Onorati, C. Vinro Lamberti, ISPRRA Institute for Environmental Protection and Research and The Higher Institute for Environmental Protection and Research (ISPRRA) is responsible for the evaluation of the potential environmental impact on marine ecosystems caused by the Produced Formation Water (PWFW) discharged from Italian gas offshore platforms. A multidisciplinary approach has been applied through the monitoring of chemical-physical characteristics of water and sediment, matched with biological investigations, such as ecotoxicological bioassays on bacteria, algae, rotifiers, crustaceans, echinoderms and fishes. The PWFW is an effluent containing complex mixtures of contaminants, the composition of which may change with time. It is therefore necessary to analyse a large number of samples taken over a long period of time in order to adequately assess the toxicity of this effluent. The present paper describes the specific topic within the whole study: the variability of the acute toxicity responses of fish to PWFW collected on two offshore gas platforms in three years (2003-2005). More sensitive life stages (post larvae of 25-45 days old) of European sea bass (Dicentrarchus labrax L., 1758) were used. Tests were performed over 24 and 96h and the dilutions 6.25-12.5-25-50-100-100% PWFW were used. The LC50% on post larvae ranged from 17.67 % to 37.42 % PWFW. The LC50% on post larvae ranged from 6.68 % to 16.51 % PWFW. The PWFW acute toxicity responses showed a temporal variability of PWFW as it is highlighted by standard deviation values of LC50 data: exposure 24h (25.61 ± 7.02% PWFW); 96h (10.84 ± 3.37 % PWFW).In accordance with GESAMP recommendations (2007), the work stresses the importance of accurate estimates and measures of oil inputs into the sea, by increasing the number and frequency of samples needed to estimate the environmental hazard of PWFW.

MO027
Tentative identification of halogenated polycyclic aromatic hydrocarbons in biota
Z. Xia, University of Manitoba; P. Thomas, C. Marvin, Environment and Climate Change Canada; W. Johnson, University of Manitoba / Chemistry; O. Francisco, I. Idowu, University of Manitoba; J. Stetefeld, University of Manitoba / Chemistry; G. Tomy, Department of Fisheries & Oceans / Department of Chemistry Polycyclic aromatic compounds (PACs) are a complex class of compounds that are present in fossil material such as petroleum oils. The most common PACs are the polycyclic aromatic hydrocarbons (PAHs). These are environmentally persistent than their non-PAH congeners. The method was used on a NIST Standard Reference Material (SRM) of mussel (Mytilus edulis) tissue (SRM-2974a) collected from a marine environment. This work has been funded by a NIST Standard Reference Material (SRM) of mussel (Mytilus edulis) tissue (SRM-2974a) collected from a marine environment. Preliminary results show that 1-chloro-px-dioxins and dibenzofurans. Because Cl and Br ions are present in the marine environment, we hypothesize that halogenated PACs can be formed and will be bioaccumulated in biota samples. Here we present a method based on high resolution mass spectrometry coupled to mass spectrometry using specific multiple reaction monitoring (MRM) transitions on the electron ionization mode to detect and quantify halogenated PACs in biological samples. The method was used on a NIST Standard Reference Material (SRM) of mussel (Mytilus edulis) tissue (SRM-2974a) collected from a marine environment.

MO028
The experience with the use of biomarkers as Risk Indicators in Environmental Risk Assessment of oil based discharges offshore
S. Sanni, International Research Institute of Stavanger / Environment; E. Lyng, D.M. Pampamini, International Research Institute of Stavanger / Environment
An approach to integrate biomarkers into probabilistic risk assessment has recently been developed and published regarding oil based discharges offshore. The main purpose has been to enable the use of monitored biomarker responses offshore as Risk Indicators in the procedures for Environmental Risk Assessment of produced water (PW) discharges. The principles of the approach and experiences obtained in applying it to existing oil field monitoring data will be presented. The approach was tested and validated using data from the latest surveys in the biomarker based Monitoring Column Monitoring (WCM) program on the Norwegian Continental Shelf for assessment of PW effects. Cases including both a typical PW discharge and an alternative discharge make the data set interesting for testing the interpretation capability of the approach. At the site with no discharge of PW at the time of the survey, an alternative contaminated by drill cuttings were used as sources of contamination. The experiences gained are discussed in relation to contaminant sources, use of the approach to provide assessment criteria for biomarkers, and for the performance of the biomarkers as risk indicators in relation to assessed environmental risk.

T0029 Tissue-level biomarkers and histopathological alterations in mussels (Mytilus trossulus) from the Baltic Sea exposed to water accommodated fractions of crude oil
J. Bir, Kluhn University / FMRT department; E. Gil-Urrutia, University of the Basque country (UPV/EHU) / Zoology and Cell Biology; A. Ahvo, Finnink Environment Institute / Marine Research Centre; R. Tunja, Finnish Environment Institute / SYKE / Marine Technology Centre; K. K. Lehto, Finnish Environmental Institute / Marine Research Centre; U. I. Kazire, University of the Basque country / UPV/EHU / CBET Research Group Dept Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PEIF; I. Marigomez, Euskal Herriko Unibertsitatea / Zoology & Animal Cell Biology Sci & Tech Fac); M. Soto, University of the Basque Country / BIIC / Research Centre for Experimental Marine Biology and Biotechnology PIEUPV/EHU

The brackish Baltic Sea is a fragile ecosystem potentially sensitive to oil spills. Chemical dispersants are an effective method to mitigate coastal impacts of oil spills; however, oil treated with dispersants may have unknown toxic effects on biota. The Baltic Sea blue mussel (Mytilus trossulus) is a particular variety of marine mussels adapted to low salinity. Early winter mussels were collected scuba diving in Tvärminne (Finland) in November 2016, taken to laboratory facilities and acclimated at the experimental temperature of 5ºC to two different salinity regimes, the local 5.6 and the artificially increased 15.0 representing the southern Baltic Sea. Mussels were exposed to water accommodated fractions (WAF) and chemically dispersed WAF (dispersed Finnosol OSR 51) mixtures (WAF-D) and sampled at 0, 1, 7 and 21 d. Tissue level biomarkers were investigated to determine the following biological responses: cell type composition (volume density of basophilic cells, V\text{bas}) of the digestive gland epithelium, structural changes of digestive alveoli (mean luminal radius/mean epithelial thickness, MLR/MET), mean epithelial thickness/mean diverticular radius (MET/MDR), connective/ diverticulum ratio (CTD), gonadal development and other histopathological alterations in digestive gland, gonad and gills. V\text{bas} increased significantly after 1 d in mussels exposed to WAF and WAF-D at the salinity of 15.0, and decreased afterwards. MLR/MET changed markedly with exposure time at 15.0 whereas MET/MDR showed no response. High CTD values in mussels observed at the salinity of 5.6 indicate a poorer condition of the digestive gland at low salinities that are similar to those of the mussel’s natural environment (atrophic vacuolisation, haemocytic infiltration, granulocytomiasis) were assessed, being more evident in mussels exposed to WAF and WAF-D (21d). Salinity is a major factor controlling the biology of mussels in the Baltic Sea. The results obtained here indicate that during the early winter the health of native mussels in the very low salinity central-northern part of the sea is more easily impaired than in those inhabiting the more saline southern regions. The current study is among the first ones applying tissue level biomarkers in Mytilus trossulus in the Baltic Sea and provides preliminary reference values for future biomonitoring programmes in the area. Acknowledgements: Funded GRACE project (EU H2020 grant N°769266) and a Basque Gov. fellowship to EGU

MO030 Toxicity of diluted bitumen to freshwater fish and invertebrates
P.Y. Robidoux, V. Bérubé, AGAT Laboratories Ltd / Specialty services Division; J. Leblanc, Fisheries and Oceans Canada / Biologist, Contaminated Sites; M. Desrosiers, Public Services and Procurement Canada

Fish may invest time and energy in the collection and consumption of two blends of diluted bitumen ("dilbit") and weathered dilbit on freshwater fish and invertebrates after exposure to vidiferent concentrations of physically-dispersed (water accommodated fraction; WAF) and chemically-dispersed (chemically-enhanced WAF; CEWAF) Toxicity of weathered, unweathered and dispersed Access Western Blend (AWB) dilbit was evaluated on fathead minnow (Pimephales promelas). Toxicity of weathered and unweathered Cold Lake Blend (CLB) dilbit was assessed on Rainbow trout (Oncorhynchus mykiss), and two invertebrate species, daphnia (Daphnia magna) and ceriodaphnia (Ceriodaphnia dubia). For fathead minnow, unweathered AWB demonstrated a significantly higher toxicity (LC50-96 h = 0.628 g/L) compared to the weathered AWB (LC50-96h = 2.06 g/L). Chronic toxic tests showed that fathead minnow lethality was also higher for AWB (LC50-7 d = 0.593 g/L) compared to the weathered AWB (LC50-7 d = 1.31 g/L) whereas larval growth toxicity was lower for AWB (IC50-7 d = 0.312 g/L) compared to the weathered dilbit (IC50-7 d = 0.096 g/L). Rainbow trout exposed to unweathered CLB demonstrated a significantly higher toxicity (LC50-96h = 5.66 g/L) compared to the weathered CLB (LC50-96h = 1.86 g/L) and LC50-96h was also observed on ceriodaphnia exposed to the CLB WAF with no mortality was observed with the weathered CLB. The reproductive effects on ceriodaphnia were greater with the CLB (IC50 < 1.0) than with the weathered CLB (IC50 = 1.99 g/L). Volatile organic compounds (VOC), polyacrilic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH) increased as the dilbit WAF increased.

MO031 Toxicity of produced water from offshore oil production in Norway and corresponding polar and apolar fractions
T. Starseth, A. Booth, SINTEF Ocean / Environmental Technology; D. Altin, Björn, Sundgren and Brunnswijk; SINTEF Materials and Chemistry / Mass Spectrometry; M.U. Ransburg, L. Sørensen, B. Hansen, SINTEF Ocean / Environmental Technology; W. Robson, University of Plymouth; P. McCormack, University of Plymouth; S.J. Rowland, University of Plymouth / School of Geography Earth and Environmental; L. Faknness, SINTEF Ocean / Environmental Technology Regulation of produced water (PW) discharges on the Norwegian continental shelf is based on a maximum 0.6% toxicity may be acceptable, with cover, means of conventional oil quantification methods based on traditional GC is limited when it comes to polar compounds that originate from produced crude oils. Furthermore, the use of treatment or production chemicals might also contribute to the overall PW toxicity. As a result, there may be discrepancies between measured concentrations of organic compounds and the total PW compounds that contribute to the overall toxicity. The objective of this study was to test for oil based discharges offshore. The main tests used were toxicity tests using nauplii of the marine copepod Acartia tonsa. LC50 values for the total PW extracts ranged between 0.05–0.98 mg L-1 (based on total GC amenable fraction). LC50 values for the toxic fraction of the current PWs were ranging between 0.17–0.57 mg L-1. Interestingly, toxicity was mainly attributed to the polar fraction of the fourth PW, with an LC50 of 0.05 mg L-1. For the PWs where toxicity mostly related to the polar fraction, this fraction spanned from 16–55% of the total PW (GC amenable fraction analysis). For the PW where toxicity mostly related to the apolar fraction this was 35%. This study demonstrates that the toxicity test can be used as a tool for the PWs were currently poorly characterized. Polar fractions may contain compounds not amenable to GC, or that can contribute to the GC-based quantification of oil in water. This suggests that PW toxicity is not directly correlated with the GC quantifiable compounds that are used for regulating discharges today. Further studies should be pursued with a wider array of PWs from a range of sources to determine if alternative methods of characterization are needed for regulation of PW discharges.

MO032 Toxicokinetics of oil components in Arctic copepods
I. Øverjordet, SINTEF Materials and Chemistry / Environmental Technology; R. Nepstad, SINTEF Ocean / Monitoring and Modelling; B. Hansen, SINTEF Ocean / Environmental Technology; T. Nordtug, SINTEF Ocean / Environmental Technology; L. Faksness, SINTEF Ocean / Environmental Technology

To comprehend the implications of large oil spills in the Arctic marine environment, we need a better understanding of the toxicokinetics of oil in true Arctic species. The central carbon chain and its waste products form the carbon chain, as well as its life history strategies and Arctic adaptation, makes it a relevant and valuable test species to provide empirical data on oil component kinetics. C. hyperboreus of developmental stage copepodite three (CIII) and five (CV) were exposed to the water soluble fraction (WSF) of crude oil (Troll B) in continuous renewal system (4 or 8 d) followed by a recovery period (20 or 35 d). Water based oil fractions and body burdens of oil were measured at i intervals during the exposure and recovery period. One compartment toxicokinetic models were fitted to the experimental data to estimate bioconcentration factors (BCFs) and elimination rates (Ke). The BCFs were consistently higher for the lipid-rich CVs compared to the CIIIs, indicating a higher bioaccumulation potential in the lipid-rich stage. The higher lipid volume fractions may explain the higher BCFs, although other factors like body size and activity levels may have contributed as well. The BCFs are well predicted by the octanol-water partitioning coefficient (log Kow). The slope of the relationship, however, differed between the lipid-poor CIIIs and the lipid-rich CVs. For the
MO035 Sea-bird-derived contaminants and genotoxicity in Collembola from the Arctic S. Kristiansen, University of Oslo / Department of Biosciences; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Biosciences; H. Leinaas, University of Oslo / Department of Biosciences; G.W. Gabrielsen, Norwegian Polar Institute; D. Herzke, NILU Norwegian Institute for Air Research; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences

Sea-birds occupy high trophic positions and due to biomagnification their bodies contain high concentrations of many anthropogenic contaminants. In the Arctic they have been shown to function as important bioveectors of contaminants from ocean to land. The tundra near bird cliffs is heavily influenced by nutrients and contaminant-enriched guano and is generally characterised by rich and diverse vegetation. In these areas, springtails (Collembola) contribute to a high proportion of the biomass. They thus play a vital role in the transformation processes such as decomposition and mineralization. The aim of this study was to determine the exposure, accumulation and effects of seabird-derived contaminants on Collembola. Two Collembola species and their habitat (soil/moss) were sampled at 7 sites with high, medium and low seabird influence in West Spitsbergen, Svalbard, and analysed for a wide range of organic contaminants, mercury (Hg), and stable isotopes of carbon and nitrogen (δ13C and δ15N, respectively). In addition, Collembola were analysed for genotoxic responses, i.e. the amount of DNA strand breaks and micronucleus frequency. Seabird influence (indicated by δ15N) and contaminant concentrations were indicated to be higher in soil/moss sampled closer to the bird cliffs (0–150 m) compared to further away (250–400 m) within the same site. When comparing among sites overall, no association between δ15N and contaminant load was found. The total contaminant loads in habitat samples were dominated by Hg, while no trend was found for organic contaminants. Contaminant concentrations in Collembola were dominated by Hg, followed by hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs) or polybrominated diphenyl ethers (PBDEs), and chlorodanes (CHLs). No association was observed between contaminant concentrations in Collembola and habitat DNA fragmentaion was higher in Collembola from sites with high seabird influence, compared to sites with medium and low. No differences in micronucleus frequency (MN) was found between sites or species. This is the first study on MN in Collembola and should be further explored. DNA fragmentation, sensitivity to induced DNA fragmentation and micronucleus frequency were associated with both MN and contaminant levels, increasing with concentrations of lower chlorinated PCBs and CHLs. The sensitivity to induced oxidative stress was negatively correlated with higher chlorinated PCBs (6–7 chlorine substitutions).

MO036 Higher contaminants and poorer condition in an Antarctic avian top predator from 2001 to 2013 H.K. Midthaug, Department of Biosciences, University of Oslo / Department of Biosciences; J.O. Busnæs, Norwegian Institute for Nature Research / Fram Centre; A. Polder, Norwegian University of Life Sciences / Department of Food Safety and Infection Biology; E. Borga, Department of Biosciences, University of Oslo / Department of Biosciences

Antarctic seabirds have been associated with chemical exposure to the Antarctic ecosystem has been considered low. However, recent investigations have shown that south polar skua (Catharacta maccormicki) has the highest levels of biomagnifying contaminants among Antarctic seabirds. The present study quantifies OHC levels in south polar skua blood, and evaluate associations between contaminant occurrence, diet, trophic position, biological variables and day of sampling. Furthermore, the study investigates temporal change of organochlorine contaminant (OCs) by comparing with previous data from the same colony, collected during the season of 2001/2002, South polar skuas were sampled during the breeding season of 2013/2014 in Svarthamaren, Dronning Maud Land, Antarctica. Whole blood was analyzed for 87 OHCs of which 56 were detected. Stable isotope ratio of carbon (δ13C) and nitrogen (δ15N), and ω-hexadecatrienoic acid (ω-3) in blood, were used to determine carbon source and relative trophic position, respectively. In 2013/2014, predominant contaminants were Mirex (8484 ng/g lw) and Hexachlorobenzene (HCB) (3561 ng/g lw). These levels were higher than those reported from other south polar colonies and Antarctic seabirds at similar ecological niches. Multivariate analysis indicated that skuas sampled late in the breeding season had higher concentration of perfluoralkyl substances (PFASs) and lower relative contributions of contaminants with higher degrees of polybrominated diphenyl ethers (PBDEs). Due to low intraspecific variance in δ13C and δ15N, no significant associations were found between OHCS and isotopes. However, lack of associations could also be due to influence of migration, wintering habitat and different turnover rates in OHCS and isotopes. Skuas from 2013/2014 had significantly higher contributions of most OCs and a lower body condition than skuas from 2001/2002. ω-3/HCB, Mirex and HCB increased with 105%, 40% and 60%, respectively, between 2001/2002 and 2013/2014. Ratios of Mirex/ω-3 and Mirex/HCB decreased between the two seasons, suggesting stabilizing Mirex levels and possibly declining levels in the future. Further studies should elucidate the effects of wintering grounds and diet, as well as the level and contaminant occurrence in Antarctic Petrel (Thalassoica antarctica), the main prey of Antarctic top predators.

MO034 Using the hagfish (Myxine glutinosa) to study biological effects of a wreck filled with chemical munitions A. Ahvola, Finnish Environment Institute / Marine Research Centre; H. Niemiokki, Finnish Institute for Verification of the Chemical Weapons Convention / Department of Chemistry, University of Helsinki; K. Straumer, Thünen Institute of Fisheries Ecology; J.A. Tornes, Norwegian Defense Research Establishment; P. Vuorinen, Finnish Institute for Verification of Chemical Weapons Convention / Department of Chemistry, University of Helsinki; T. Lang, Thünen Institute of Fisheries Ecology; A. Lastumäki, K.K. Lehtonen, Finnish Environment Institute / Marine Research Centre

The sea bottom of the Skagerrak Strait (North Sea) contains ca. 45,000 tonnes of chemical warfare agents (CWA) dumped after the Second World War. Entire ships containing CWAs were stored in the area in different states of deterioration (ca. 600 m) from the area in different states of deterioration. The current programme of the EU Baltic Sea Region Interreg project DAIMON – “Detection, Aliencement and Mitigation of Ocean Dumped Agents” – was initiated to determine the leakage of CWAs and their possible biological effects. From the few samples that could be collected in situ, CWAs were detected both in the water column and on the sea floor. The peak capacity and vast database of information provided by GC×GC/HR-TOF-MS for different sample matrices is an asset to the project. Two dimensions of GC×GC have been designed to cope with the complexity of the aliphatic, aromatic, halogenated and substituted PACs, and their alkylated homologues. The peak capacity of the two dimensional GC×GC has immensely improved analysis of these complex compounds in environmental matrices. In this study, the separation and identification of aliphatic and aromatic hydrocarbons, chlorinated hydrocarbons (CIs), chlorine/nitrogen substituted PACs (CIIIs), the slope was close to unity, indicating a similarity between structural homologues, especially those that are of environmental significance, is difficult if not impossible with conventional one-dimensional gas chromatography (GC). The peak capacity of the two dimensional-GC has immensely improved analysis of these complex compounds in environmental matrices. In this study, the separation and identification of aliphatic and aromatic hydrocarbons, chlorinated hydrocarbons (CIs), chlorine/nitrogen substituted PACs (CIIIs), the slope was close to unity, indicating a similarity between structural homologues, especially those that are of environmental significance, is difficult if not impossible with conventional one-dimensional gas chromatography (GC). The peak capacity of the two dimensional-GC has immensely improved analysis of these complex compounds in environmental matrices. In this study, the separation and identification of aliphatic and aromatic hydrocarbons, chlorinated hydrocarbons (CIs), chlorine/nitrogen substituted PACs (CIIIs), the slope was close to unity, indicating a similarity between structural homologues, especially those that are of environmental significance, is difficult if not impossible with conventional one-dimensional gas chromatography (GC). 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of south polar skua during the breeding season. Keywords: Antarcritic, south polar skua, stable isotopes, temporal variation, OHC

MO037 Evaluation of malformations induced by a hospital effluent of Toluca (Estado de Mexico) in Lithobates catesbeianus H. Islas-Torres, L. Hernandez-Navarro, Universidad Autonoma del Estado de Mexico / Toxicology and Environmental Toxicology; I. Perez-Alvarez, Universidad Autonoma del Estado de Mexico / Environmental Toxicology; L. Gómez-Oliván, Autonomous University of the State of Mexico / Chemistry; M. Galar-Martinez, Instituto Politecnico Nacional, Escuela Nacional de Ciencias Biologicas; N. Sanjuan-Reyes, Autonomous University of the State of Mexico / Chemistry; O. Dublan-Garcia, Universidad Autonoma del Estado de Mexico / Biochemistry; A. Churzyńska, J. Martínez, E. Hernández-Navarro, Universidad Autonoma del Estado de Mexico / Toxicology

Hospital effluents are important from the ecotoxicological point of view and are an important source of pollutants emission, among which are pharmaceutical products, chemical residues, radioelements, disinfectants and heavy metals, among others, which are waste of daily activities and has reported that they can reach concentrations between 4 and 150 times higher than those detected in municipal effluents. In addition to this, they usually do not have adequate pre-treatment before their emission, so they can be mixed with other effluents from homes, industries and municipal wastewater, which can subsequently generate interactions, enhance effects and create synergies, which lead to induce adverse effects on the environment, so it is important to study. The Estado de Mexico is located in the center of the country and is considered the entity with the largest population and according to data reported in 2015, it has 1835 medical units of different levels of care. On the other hand, Lithobates catesbeianus is a species considered native of the state and has been proposed by the government as an alternative to food supplement (due to its protein content). Due to the aforementioned, the objective of this work was to evaluate the malformations generated by a hospital effluent of Toluca in this species and compare with Xenopus laevis, species that is used as a preferred bioindicator, using the frog embryo teratogenesis assay: Xenopus (FETAX). For this purpose oocytes in mid-blastula transition were exposed for 96 h to six different concentrations of the effluent (0.1, 0.3, 0.5, 0.7, 0.9 and 1%), subsequently, the mean lethal concentration (LC50) effective concentration inducing 50% malformation (EC50), and the teratogenic index (TI) was obtained. Results indicates that lower concentrations of the hospital effluent induced slightly higher malformations and lethal effects in X. laevis (EC50=0.132%, LC50=0.508%,TI=3.8) and in L. catesbeianus (EC50=0.351%, LC50=1.431%,TI=4.0). The main alterations being microcephaly, cardiac and facial edema malformations in the eye, notochord, tail, fin and intestine. However, the lightest concentration of 0.2% indicated no alterations in the species exposed to this hospital effluent will be malformed in the absence of mortality compared to X. laevis. And therefore, can be considered as a sensitive and useful species to evaluate toxic effects of contaminants with the FETAX assay.


In the frame of the joint project NiddaMan coordinated by the Goethe University Frankfurt/Main we investigated health parameters of fish from the River Nidda and its tributaries Horloff and Usa in Central Germany. The Nidda river system is regarded as a typical river system for central Europe as it passes a very densely populated area and as it is heavily influenced by anthropogenic factors including agriculture, communal waste water and industrial discharge. To get a broad overview of the situation face fish in this river system and the resulting effects, we investigated biological parameters on different levels: (I) Evaluation of water and sediment samples from the field with the Danio rerio embryo test (Dar-T), including the endpoints mortality, hatching success, heart rate, developmental delays and malformations. (II) Investigation of fish health by histopathology of actively (caged rainbow trout) and passively monitored (caught feral) fish focussing on the metabolically most important organ, the liver. (III) Additional inclusion of biomarker data like EROD activity (CYP1A1, indicating pollution with dioxin like compounds) and number of micronuclei (genotoxicity) within erythrocytes. Results show that the river system – from a biological point of view – is not in a good (as compared to the ISO 11267 guideline). The chosen concentrations of fipronil were based on the recommended doses (RD) for the control of the pest Milgusos fraysan in sugarcane crops (RD = 1.3 mg of the commercial product / kg / 24 dw soil), which means 1.04 mg of fipronil / kg dw soil. Concentrations tested were 0.06; 0.13; 0.26 and 0.52 mg fipronil kg-1 of dry weight soil. The EC50 values were 0.21; 0.18 and 0.09 (1%) kg / soil, for the first, second and third generation, respectively. According to the results, fipronil showed significant toxicity at low concentrations up to the third generation, causing effects on the reproduction and survival of Folsomia candida, and could be considered a highly dangerous pesticide for terrestrial arthropod organisms.

MO039 Multigenerational toxicity of Fipronil to Folsomia candida D.D. Oliveira, C.M. Reganhan Congelani, SCHOOL OF TECHNOLOGY UNICAMP; V. Menezes-Oliveira, Univesidade da Sao Paulo / Department of Hydraulic and Sanitation

Fipronil is a pesticide widely used on agricultural pest control, especially in sugarcane crops. This compound acts as an inhibitor of nerve signals in insects, and pose as a risk to non-target terrestrial organisms (i.e. the collemboob Folsomia candida), which plays important roles in the maintenance of soil quality. The main objective of this study was to evaluate the ecotoxicological effects on the reproduction of three generations of the Folsomia candida species when exposed to fipronil from two sides over time, under a natural tropical soil. Test procedures were adapted from the ISO 11267 guideline. The chosen concentrations of fipronil were based on the recommended doses (RD) for the control of the pest Milgusos fraysan in sugarcane crops (RD = 1.3 mg of the commercial product / kg / 24 dw soil), which means 1.04 mg of fipronil / kg dw soil. Concentrations tested were 0.06; 0.13; 0.26 and 0.52 mg fipronil kg-1 of dry weight soil. The EC50 values were 0.21; 0.18 and 0.09 (1%) kg / soil, for the first, second and third generation, respectively. According to the results, fipronil showed significant toxicity at low concentrations up to the third generation, causing effects on the reproduction and survival of Folsomia candida, and could be considered a highly dangerous pesticide for terrestrial arthropod organisms.
relationships (Pearson, R=0.11) between the ChE and the weight or sex of the birds. The weight of the birds decreased on average 1.54 g after the exposure, possibly due to the stress of capture and the lack of adaptation to captivity. The house sparrow showed to be a species sensitive to the presence of OP compounds in the environment. It is possible that the house sparrow and other birds that co-inhabit the agricultural areas where malathion is applied, as well as other OP insecticides, are prone to develop different levels of intoxication and that in some cases their health condition is compromised.

**MO042 Implementation of a worst-case landscape scenario for population modelling of a fungicide applied in cereals**
M. Wang, WSC Scientific Group / Dept Efate; M. Preuss, Bayer Agr / Environmental Safety; M. Elbing, Bayer AG Crop Science Division / Ecotoxicology - Terrestrial Vertebrates Expert Team

In many cases EU member states prefer the use of country specific scenarios for the exposure or risk assessment of pesticides. This is sometimes requested due to specific geographical features or agricultural practice. In the present example, we demonstrate how the specific agricultural situation of the Netherlands was taken into account for the selection of landscape scenarios for use in population modelling. It is firstly shown how a country specific landscape scenario is developed. Then, the dose response obtained in a rat reproduction study with an azole fungicide is employed in a population-level risk assessment on small herbivorous mammals (Common vole, Microtus arvalis). The margins of safety obtained in that assessment were found as being between these two non-linear effects would be expected under realistic worst-case field conditions.

**MO043 Biomonitoring and validation of non-invasive samples for the analysis of metals in freshwater turtle carapace scales**
I. Lopes, J. Pareja Carrera, IREC-UCLM / IREC-UCLM; A. Rodriguez-Perez, UCLM-IREC; M. Martinez-Haro, IREC-Instituto de Investigación en Recursos Cinegéticos / Department of Life Sciences; R. Mateo, IREC-CSIC-UCLM / Grupo de Toxicología de Fauna Silvestre; M. Ortiz Santaliestra, Institute for Game and Wildlife Research (IREC) UCLM-CSIC-JCCM

The mobilization of metals from the earth’s crust due to anthropogenic activities, such as mining, is one of the main contamination routes for wildlife. With the objective of biomonitoring and validating non-invasive methods for metal analysis in reptiles, levels of lead (Pb) and mercury (Hg) in blood, faeces and carapace scales of freshwater turtles (Mauremys leprosa, n=86) from historical mining areas (i.e. Valle de Alcudia-Sierra Madrona district for Pb, Almadén district for Hg) were measured. The highest levels of blood Pb were found in the animals collected from the area of Valle de Alcudia-Sierra Madrona, more specifically from Solana del Pino, with an average (±SD) of 5.59±3.66 μg/g dry weight (dw). Individuals from this location showed the clearest evidences of oxidative stress, as estimated from the highest values of malondialdehyde (biomarker of lipid peroxidation) and superoxide dismutase activity. However, no correlation was found between the biomarkers and blood Pb levels. Similarly, the highest levels of Hg were detected in the animals collected from the area of Almadén, specifically from Almadenejos, with an average (±SD) of 8.83±8.84 μg/g dw. These individuals showed no evidences of oxidative stress, but presented increased activity of glutathione peroxidase and reduced glutathione levels relative to the rest of populations, which would indicate that antioxidant system is protecting from oxidative damage to occur. Blood levels of these two elements were above those reported as susceptible to cause sublethal effects in reptiles for the vast majority of terrapins from the most contaminated sites (100% of terrapins from Solana del Pino with blood Pb levels > 15 μg/dl; 70.3% from Almadenejos with blood Hg levels > 2.76 μg/g dw). Faeces and carapace scales obtained non-invasively correlated significantly with blood levels for the case of Pb (R ≥ 0.765, P < 0.001), but not for Hg (R ≤ 0.362, P ≥ 0.127). Thus, these samples could be used as non-invasive methods for the analysis of Pb bioavailability in M. leprosa, and by extension in reptiles, which will contribute to the development of ecotoxicology in reptiles, a group very little studied in this regard.

**MO044 An analysis of important life stages, exposure routes and test endpoints in amphibians and coverage by existing risk assessment regulatory requirements for plant protection products, part 1**
A. Aldrich, Agroscope / Ecotoxicology; C. Berg, Uppsala universitet, Dept. of Environmental Toxicology / Dept of Environmental Toxicology; M. Ortiz Santaliestra, Institute for Game and Wildlife Research (IREC) UCLM-CSIC-JCCM; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; S.M. Weir, Queens University of Charlotte / Department of Biology

Concerns have been raised that the current risk assessment of plant protection products (PPP) may not sufficiently cover the risk to amphibians and reptiles. To address these concerns, the European Food Safety Authority (EFSA) has published a Scientific Opinion addressing the state of the science regarding the risk to amphibians and reptiles exposed to pesticides (EFSA 2017). A central task of the EFSA working group was to understand how well important life stages, exposure routes and endpoints are currently covered (or not) by the current risk assessment paradigm. We had four steps in this analysis: 1) Identify relevant life-stages, important exposure routes and possible endpoints with relevance to the specific protection goals (SPGs) defined for amphibians; 2) Evaluate the coverage by existing standard test guidelines with regard to these important stages/routes/effects; 3) Explore whether tests with surrogate species could provide suitable information allowing extrapolation to assess the hazard/risk for amphibians; 4) Identify proposed non-standardized test protocols suitable to address the gaps for specific protection goals defined for amphibians. Care was taken to address all relevant routes of exposure, life-stages, and short and long term effects. For amphibians, greater coverage or surrogacy exists for the aquatic larval stage and short term effects, with less coverage of the adult terrestrial stage, reproductive toxicity, and specifically for the potential terrestrial exposure routes. To cover important life stages, exposure routes and effects, tests addressing dermal overspray and reproductive toxicity in amphibians may be needed. The analysis for reptiles will be presented in a separate poster. The concerns that the current risk assessment of pesticides may not sufficiently cover the risk to amphibians were supported after the analysis of the currently available data. The exercise provides a useful base for further research necessary to advance the ecotoxicological risk assessment of amphibians within the remit of the PPP authorization.

**MO045 European common frog (Rana temporaria) larvae show subcellular responses under field-relevant Bacillus thuringiensis var. israelensis (Bti) exposure levels used in mosquito control**
S. Allgeier, B. Frombold, University Koblenz-Landau; V. Mingo, Trier University / Biogeography; C. Bruehl, University of Koblenz-Landau / Institute for Environmental Sciences

Bacillus thuringiensis var. israelensis (Bti) is presumed to be an environmental friendly agent for use in either health-related mosquito control or the reduction of nuisance associated with mosquitoes coming from temporary flooded wetlands. Amphibians co-occurring with mosquito larvae in these wetlands may be exposed to Bti products several times during their breeding season. Up until now, information regarding effects on the non-targeted group of amphibians has to be regarded rather inconsistent. On this account, we evaluated how repeated exposures to frequently used Bti formulations (VectoBac®2AS, VectoBac®WG) in field-relevant rates affect European common frog (Rana temporaria) larvae. In a laboratory approach, tadpoles experienced exposure conditions similar to realistic mosquito control in the Upper Rhine Valley (Germany). We assessed potential effects with regard to enzymatic biomarkers (glutathione-S-transferase, glutathione reductase, acetylcholine esterase), development, body condition and survival until the end of metamorphosis. Regardless of the formulation, delivery form or application rate, tadpole survival rates and time to metamorphosis were slightly reduced after repeated Bti exposures, while body condition was similar throughout the treatments. Furthermore, Bti induced significant increases for all enzymatic activities irrespectively of the applied field rate and formulation, indicating oxidative stress as well as unspecific neurotoxic effects. Repeatedly executed Bti applications, especially acting on early developmental stages, seem to increase the risk for adverse effects. The examination of several biochemical markers is needed to evaluate the ecotoxicological risk of Bti for amphibian populations, especially in the context of worldwide amphibian declines. Following the precautionary principle, the implementation of certain thresholds for application numbers and intervals should be considered in order to ensure environmentally friendly mosquito control programs, especially in areas originally designated for nature conservation.

**MO046 Influence of salinity and temperature on tadpoles of Xenopus laevis**
C. Monteiro, R. Alves, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; A.M. Soares, University of Aveiro / department of Biology & CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

Worldwide coastal low-lying ecosystems are experiencing an increased salinity due to sea-level rise and saltwater intrusion. Coastal areas provide important refugia for endangered species. The Intergovernmental Panel for Climate Changes regarding the increase of mean temperatures, until 2100, and consequent sea level rise, it is foreseen an increase in the number of coastal ecosystems suffering from such salinization. Among coastal ecosystems that will be impacted with seawater intrusion are wetlands, which constitute hotspots of biodiversity and represent relevant ecosystems for amphibians. This class of vertebrates holds the highest percentage of endangered species and is considered very vulnerable to salinity changes. In this context, the present study aimed at evaluating the influence of temperature on the adverse effects that increase of salinity may cause to tadpoles of the amphibian species Xenopus laevis. To address this objective, X. laevis tadpoles ( Gosner 25) were exposed to a range of 5 NaCl concentrations under three temperatures: 20, 23 and 26ºC. The following parameters were monitored during the course of the experiment: feeding rate, body weight and growth rates. The differences reported for size between control and NaCl concentrations were mainly due to the tail length. For all concentrations, the feeding rate decreased with increasing NaCl concentration. As well, body weight decreased...
with increasing salinity. Although significant interactions between temperature and salt concentration were registered, a pattern of toxicity; amphibia

MO047

EVALUATING THE EFFECTS OF THE EXPOSURE OF LARVAE OF DENDROPSOPHUS CALDOSANUS (ANURA: HYLIIDAE) TO WATER CONTAMINATED BY ANTHROPIC-GENIC ACTIVITIES IN A RIVER BASIN OF THE COLOMBIAN ANDES

V. R. Casanueva, Universidad de Caldas; B. Toro, Universidad de Caldas / Biological Sciences

The pollution generated by agriculture, livestock and mining have impacted the watersheds in the Colombian Andes. Amphibians have been used to evaluate this contamination due its biophase lifecycle, which has made them ideal models in aquatic ecotoxicology. The objectives of this work were: 1) to determine if tadpoles of D. calodosa exposed to contaminants of agricultural, livestock and mining (with mercury: Hg, and with mercury and cyanide: Hg/CN) varied in the snout-vent length (SVL), tail length (TL), head width (HW), and body weight, and 2) to evaluate the effect of exposure on metamorphosis and behavior of the larvae. The AMPHITOX protocol was followed using ten larvae in each of the treatments and in the control, which were exposed from the moment of hatching to complete metamorphosis. Significant differences were found in the LRC between the larvae of the control and the Hg/CN mining treatment (Z= -28.92, p= 0.000) and between Hg/CN mining and agriculture treatments (Z= 25.325, p= 0.001) after 50 days of exposure. Differences in LC were found between the larvae of the control and the Hg/CN mining treatment (Z= -25.57, p= 0.001), and between Hg/CN mining and Hg mining treatments (Z= 21.525, p= 0.009) in the same time. The weight did not show differences. The majority of larvae of the control and the agriculture treatment showed similar development rates, reaching stage 46 between days 60 and 75 of exposure. While tadpoles exposed to Hg/CN mining did not complete the metamorphosis and reached stage 42 between days 50 and 55. Surface flotation was the activity that was most stable at the time of exposure, presenting percentages of individuals greater than 60% in the control (81%), and in the agriculture (70%) and Hg mining treatments (65%), between the last days of exposure evaluated: 22 to 28. It is shown that 1) the effects on growth of anuran larvae due to agricultural, livestock and mining contamination are similar. However, samples contaminated by mining produce smaller tadpoles than agriculture and livestock, and 2) tadpoles exposed to agricultural and livestock contamination, unlike other studies which recorded the failure of metamorphosis, show a time of this process that approximates to the time that the species experienced in the control (134 days) and probably, to the time of this in situ.

MO048

Risks for amphibiens and reptiles by dermal exposure to pesticides

F. Smirniotis, EFSA / Pesticides Unit; P.J. Adrianares, Alterra Wageningen University and Research Centre; R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit; K. Machera, Benaki Phytopathological Institute / Department of Pesticides Control & Phytopharmacy, Athens, Greece

Amphibian and reptilian species are found in agricultural landscapes. Some inhabit water bodies either permanently or during some time of their life cycle. Others use predominantly more terrestrial habitats. Some amphibian species lost many local populations, and potential pesticide exposure during maturation might impact survival during seasonal bottlenecks in winter from one to the next reproductive season. Furthermore, from a regulatory perspective and due to the one-reproductive-season-duration of most field effects studies in wildlife, there is an increasing concern on potential long-term effects from exposure occurring delayed or that the reproduction in the following season might be affected by exposure during a previous application season. Against this background we monitored individually marked common vole populations from a long term effect study on spray applications of Dithane M-45 (Mancozeb 80% WP) during one reproductive season further on into the following reproductive season. The test item Dithane M-45 was applied four times in June according to Good Agricultural Practice at an application rate of 2 kg a.s./ha. Trapping and marking of voles in the same investigation plots was conducted until September, followed by further trapping until spring of the following year and the onset of the new reproductive cycle. Reproductive parameters recorded as indicators of potential long-term effects resulted in very similar patterns in treatment and control plots, and the data show no indication that common voles were negatively affected by multiple applications of the test item also in the following year. Furthermore and up to now not documented for wild living common voles, the data gives evidence that free-living common vole individuals can reproduce for more than one reproductive season.

MO051

An analysis of important life stages, exposure routes and test endpoints in reptiles with regard to coverage by existing risk assessment regulatory requirements for pesticides

A. Aldrich, Agroscope / Ecotoxicology; C. Berg, Upsala universitet, Dept. of Environmental Toxicology / Dept of Environmental Toxicology; M. Ortiz Santalarco; Instituto de Game and Wildlife Research (IREC) / UCLM-CSIC-JCCM; S. Peiper, German Federal Environment Agency (UBA) / Plant Protection Products; S.M. Weir, Queens University of Charlotte / Biology Concerns have been raised that the current risk assessment of pesticides may not sufficiently cover the risk to amphibians and reptiles. To address these concerns, the European Food Safety Authority (EFSA) has published a Scientific Opinion concerning potential long-term effects from exposure to pesticides (EFSA 2017). A central task of the EFSA working group was to understand how well important life stages, exposure routes and endpoints are currently covered (or not) by the current risk assessment methodology. We had four steps in this analysis: 1) Identify relevant life-stages, important exposure routes and possible endpoints with relevance to the specific protection goals (SPGs) defined for these groups; 2) Evaluate the coverage by existing standard test guidelines with regard to these important stages/routes/effects; 3) Explore whether tests with surrogate species could provide suitable information allowing for extrapolation to assess the hazard/risk for amphibians and reptiles; 4) Identify proposed
non-standardized test protocols suitable to address the gaps for specific protection goals defined for amphibians and reptiles. Care was taken to address all relevant routes of exposure, life-stages, and short and long term effects. Reptiles have very little data with which to assess the coverage of important life stages and exposure routes. Current knowledge suggests that surrogacy based on bird or mammal data may not be appropriate for the juvenile and adult stages of reptiles, though data are very limited. Reptile eggs are not covered by any aspect of the current risk assessment paradigm, but it is unknown to what extent reptile eggs lay eggs in crop fields, and how likely exposures are to occur to eggs under realistic scenarios. Therefore, more data are needed to determine if this is a vulnerable life stage that needs specific consideration. The concerns that the current risk assessment of pesticides may not sufficiently cover the risk to reptiles were supported after the analysis of the currently available data. The exercise provides a useful base for further research necessary to advance the ecotoxicological risk assessment of reptiles within the remit of the pesticide authorisation.

**MO052 AmphibiMove: Moving patterns and microhabitat selection of European anurans in agricultural landscapes**


The current decline of amphibian populations on global and local scales is discussed by scientists around the world. Studies suggest that enhanced application of plant protection products (PPP) is one of the main reasons that today amphibians represent the most endangered vertebrate group in Europe. The first version of a scientific opinion currently released by EFSA (European Food Safety Authority) highlights the need for including amphibians in the risk assessment of plant protection products. Specifics in terms of physiology (e.g., permeable skin) and ecological parameters (e.g., aquatic and terrestrial life-stages in combination to complex moving patterns and habitat preferences) make this taxon in particular vulnerable to pesticide applications in agricultural landscapes. It is emphasized that detailed ecological data of especially terrestrial amphibians is still under-represented but required for a comprehensive risk evaluation of all amphibian life-stages. The aim of the project AmphibiMove is to fill the gap on terrestrial life-stages of European anurans with focus on moving patterns and microhabitat selection in agricultural landscapes. At two study sites individuals of common toads (Bufo bufo) and common frogs (Rana temporaria) were caught at and around their breeding ponds, fit with a transmitter and afterwards tracked via radio-telemetry. Locations, biotic and abiotic parameters of the selected microhabitats were recorded daily. We show preliminary results of the first period of data collection for common toads from March to October 2017.

**MO053 A quantitative AOP for activation of the aryl hydrocarbon receptor leading to early life stage mortality in amphibians and reptiles**

A. Schroeder, I. Mateo / Institute for Plant Protection in Horticulture and Forests, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

The current decline of amphibian populations and local scales is discussed by scientists around the world. Studies suggest that enhanced application of plant protection products (PPP) is one of the main reasons that today amphibians represent the most endangered vertebrate group in Europe. The first version of a scientific opinion currently released by EFSA (European Food Safety Authority) highlights the need for including amphibians in the risk assessment of plant protection products. Specifics in terms of physiology (e.g., permeable skin) and ecological parameters (e.g., aquatic and terrestrial life-stages in combination to complex moving patterns and habitat preferences) make this taxon in particular vulnerable to pesticide applications in agricultural landscapes. It is emphasized that detailed ecological data of especially terrestrial amphibians is still under-represented but required for a comprehensive risk evaluation of all amphibian life-stages. The aim of the project AmphibiMove is to fill the gap on terrestrial life-stages of European anurans with focus on moving patterns and microhabitat selection in agricultural landscapes. At two study sites individuals of common toads (Bufo bufo) and common frogs (Rana temporaria) were caught at and around their breeding ponds, fit with a transmitter and afterwards tracked via radio-telemetry. Locations, biotic and abiotic parameters of the selected microhabitats were recorded daily. We show preliminary results of the first period of data collection for common toads from March to October 2017.

**MO054 Do historically metal-exposed amphibian populations acquire resistance to lethal levels?**

F. P. Morão, S. C. Novaes, Polytechnic Institute of Leiria / MARE IPLeiria; I. Vieira, A. Francisco / Institute of Game and Wildlife Research (IREC) / CSIC; I. Pinto, M. J. Costa / CSIC / Department of Environmental Chemistry; R. Ribeiro, Universidade de Coimbra / Life Sciences; R. Mateo, IREC-CSIC: UCLM / Grupo de Toxicología de Fauna Silvestre; L. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

The aims of this work were to (1) determine oxidative stress and metal burden in anuran tadpoles from historically metal exposed populations (Hg/Pb), and (2) assess if tadpoles from impacted sites have increased tolerance to metals relative to tadpoles from reference sites. Metal body burden, oxidative stress biomarkers and metallothioneins (MT) were measured in Pelophylax perezi tadpoles from reference and metal contaminated sites. Additional tadpoles (20 per site) were collected and exposed in lab conditions during 24h to Hg or Pb levels above the median lethal concentrations reported for amphibians (1.5 and 10.5 mg/l, respectively). The parameters mentioned above plus mortality were monitored at the end of the assay. Field-collected tadpoles from Pb and Hg polluted sites had higher metal body burden than those from reference sites (median per site as d.w. 540.4-708.1 vs 2.6-9.5 mg Pb/g, 768.2-3103.5 vs 0.01 ng Hg/g; all p< 0.01). Levels of MT (median, µg/g tissue) were significantly higher in tadpoles from Hg polluted sites than in the rest of locations (248.5-307.7 vs. 63.9-138.66 µg/g, p<0.01), suggesting that MT expression can be induced in natural populations, by the sum of environmental factors. Exposure to Hg caused mortality of all individuals, while Pb did not result lethal to tadpoles. Laboratory exposure revealed that experimental treatment rather than pollution at the origin site determined Pb body burden (controls: from reference site 96.7-120.4 µg/g, from Pb site 118-491.6 µg/g; Pb-exposed: from reference site 369.97-9,4760 µg/g from Pb site: 9043.5-7845.2 ng/g), showing that Pb was readily bioavailable for exposed tadpoles. Lab exposure to Pb increased MT levels in tadpoles from reference sites (exposed vs. non-exposed: 116.3 vs. 41.70 µg/g; p< 0.01), but not in those from Pb-polluted areas. Oxidative stress biomarkers did not differ either between origin sites or because of experimental exposure to Pb. MT levels in tadpoles from reference populations that were taken to the laboratory and kept in laboratory conditions was not different. Metabolic parameters mentioned above plus mortality were monitored at the end of the laboratory (105.99-138.66 vs 29.27-41.70 µg/g; p< 0.05). This could be consequence of a reduction in the laboratory of stress sources other than metals that can also induce MT synthesis (e.g. thermal stress). The fact that this decrease was not observed in tadpoles from Pb-polluted sites (105.61-109.41 vs 193.50-130.23 µg/g; p< 0.05) would suggest that these animals may have high constitutive MT levels.

**MO055 Assessment of metal contamination levels and stress responses of endangered sea turtles of São Tomé and Principe**

I. P. Morão, S. C. Novaes, Polytechnic Institute of Leiria / MARE IPLeiria; I. Vieira, A. Francisco / Institute of Game and Wildlife Research (IREC) / CSIC; I. Pinto, M. J. Costa / CSIC / Department of Environmental Chemistry; R. Ribeiro, Universidade de Coimbra / Life Sciences; R. Mateo, IREC-CSIC: UCLM / Grupo de Toxicología de Fauna Silvestre; L. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

São Tomé Island harbors important sea turtle nesting and feeding sites. However, insufficient enforcement of environmental laws to avoid illegal take of nesting females and eggs, associated with a great lack of knowledge about how these species interact with their environment and how human activities impact their survival in the region, constitute significant challenges for sea turtle conservation. Through current local conservation projects, some information on genetics and nutrition of sea turtle populations is being unveiled but very little is known about how these populations in remote and polluted areas. Oxidative stress is one of the key factors that determines the mortality of the hatchlings. The aim of this work was to assess the metal contamination accumulated by two species of S. Tomé sea turtles (Eretmochelys imbricata and Chelonia mydas) and infer about possible impacts of such contamination on their general stress responses and health status. More specifically, the final goal was to find correlations between metals in their tissues and the expression of key genes involved in detoxification/sequestration and metal transport, antioxidant responses and oxidative stress, immunological responses, mitochondrial respiratory and energy production, among others, which could be indicative of these organisms health and future viability. To achieve these goals, nesting female turtles were sampled for blood and skin tissues, immediately after egg laying in their well-documented spawning sites in S. Tomé. Skin samples were collected from the right front flipper of the turtles and stored at -20°C until analysis of metal concentrations. Blood samples were withdrawn from the external jugular vein and stored in RNA later at -20°C until RNA extraction and gene expression analysis using quantitative real-time PCR (qPCR). Additionally, body mass and carapace length were also recorded, along with all information regarding

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egg spawning and its success. Results showed significant correlations between expression of some genes and metal contaminant levels, pinpointing some candidate genes to be used as biomarkers of interest for biomonitoring campaigns, which worrying function highlights the need for a close follow-up of these organisms. This study represents the first attempt to address pollutant levels and the biological impairments of such stressors in these turtle species nestling in S. Tomé which, given their classification as endangered species (IUCN red list), is of paramount importance to contribute for conservation measures and management.

**MO056**
Ecotoxicology of Africa's three largest reptiles: POPs, metals, eggs, and eggshells

H. Bouwman, North-West University / Unit for Environmental Science and Management; R. Nel, Nelson Mandela Metropolitan University / Department of Zoology; H. Kylin, Linköping University / Department of Thematic Studies Environmental Change; D. Govender, SANParks; M. Du Preez, North West University / Zoology

The Nile Crocodile (Crocodylus niloticus), Loggerhead Turtle (Caretta caretta) and Leatherbacked Turtle ( Dermochelys coriacea) are the largest reptiles in Africa. The bioaccumulation and effects of metals and metalloids on large-bodied reptiles are less well known compared with birds and mammals, especially those from Sub-Saharan Africa. Globally, reptiles are experiencing declines, and pollution is one of the hypothesized reasons for the decline. The Nile Crocodile and Loggerhead Turtle are at relatively high trophic levels, with the Nile Crocodile also being the largest predator in Africa. We sampled eggs from these three species (27 crocodile, and 10 each from the two turtle species) and analysed the shells and contents separately for metallic elements using ICP-MS. Trophic level, body size, and migratory patterns influenced the concentrations in shells and egg contents, but crocodiles generally seem to have lower concentrations than the sea turtles. Compared with data from elsewhere, sea turtle eggs had lower concentrations, but crocodile eggs had higher copper and mercury concentrations. Comparisons between eggshells and egg content elemental compositions for each species clearly showed that eggshells can not be used as proxy for egg contents. Sampling therefore, requires the collection and analyses of unhatched eggs. Relative elemental composition patterns indicated overlaps for the respective egg components and eggshells of the sea turtles, but not for the crocodiles. We found thicker eggshells significantly associated with higher iron concentrations in the crocodiles. The implications may be that hatchlings may spend more energy to break through the leathery shells, and may therefore affect reproduction. Copper had concentrations that raised concern in all three species. The strontium concentration in the eggshells of the Leatherback Turtle was high. Mercury, copper, strontium, and cadmium were monitored. Contrary to the levels noted in the Nile Crocodile, no higher copper and mercury concentrations were found as compared to those for other co-occurring pollutants, such as POPs and endocrine disrupting compounds, since sub-lethal effects, especially when the eggs are covered, is difficult to discern. Based on the work presented here and those of others, it is obvious that more studies are needed to obtain a better picture of the chemical and biological interactions involved with Africa’s three largest reptiles ‘in

**MO057**
Improving knowledge flow from consumer to environmental risk assessment

L. Villamar Bouza, s. barmaz, R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit; M. Arena, EFSA - European Food Safety Authority / Pesticides; D. Arena, EFSA - European Food Safety Authority

The assessment of pesticide residues levels in environmental matrices is part of the risk assessment for non-target organisms under Regulation (EC) no 1107/2009. In the case of risk assessments for birds and mammals, according to EFSA (2009), the Tier 1 assessment uses default values for residues levels (in terms of residue per unit dose, RUD) and residue decline (in terms of a time weighted average factor, TWA). When the Tier 1 risk assessment indicates a high risk a higher tier assessment is required. One option is to refine the estimate for the level of residues that wildlife consume through their diet by calculating specific RUDs or by deriving substance/crop specific DT50 values which are then used to recalculate the TWA factor used in the risk assessment. Often the residues studied under the common consumption risk assessment are used to derive such DT50 values. These are then further evaluated with specific kinetic tools (FOCUS kinetics). It should be noted that the refinement of the RUD values is done only in rare cases since the dataset at the basis of the default values is relatively large. These refinements allows for a more realistic assessment accounting for the differences in residues decline due to the crop type, growth stage, climatic conditions across EU zones and to species characteristics of the substance under assessment. Other parts of the data used for the consumer risk assessment for pesticides can also provide information for the environmental risk assessment. In particular, metabolism studies in plants are used for the identification of the pertinent metabolites to be further considered in the risk assessment of birds and mammals. The metabolism data for hen and rai/soft can also be used for addressing such metabolites. The main scope of this work is to further analyse the standard dataset available and the specific guidance in use for the consumer risk assessment in order to better define how the data and knowledge developed in the context of the consumer risk assessments (internationally agreed methodologies, existing guidance documents) could be integrated in the environmental risk assessment. Particular consideration is given to the possibility of extrapolation between crops, use patterns (e.g. growth stages, application number) and European zones.

**MO058**
Increasing salinisation effects on Polyphemus pediculus populations - Could historical exposure drive population declines?

S. Costa, Universidade de Aveiro / Department of Biology & CESAM, 3810-193 Aveiro, I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

Coastal wetlands are a priority for conservation because they are biodiversity hotspots and have high ecological importance in ecosystem services. However, they are increasingly exposed to strong anthropogenic pressure and climatic extremes. Additionally, Intergovernmental Panel on Climate Change (IPCC) reported alarming projections for sea levels rise in the AR5 at 2013. Within this scenario, it is foreseen the salinisation of low-lying coastal freshwater ecosystems due to the intrusion of seawater, which will adversely affect many populations of amphibians. *Polyphemus pediculus* is distributed along all coastal territory in Portugal, where there are some populations historically exposed to environmental and levels of seawater. Though this species has been reported as tolerant to high salinity levels, there is a lack of knowledge regarding long term effects of salinization to natural populations of this amphibian species. The present work aimed at characterizing the lethal and sublethal sensitivity to salinization of early life stages of *P. pediculus* originated from reference and salinized natural populations. Embryos (Gosner stage h-10) were exposed for 96h, and to what concerns to the input of pollutants to several dilutions of seawater and concentrations of NaCl (used as a surrogate of seawater to increase salinity). The following endpoints were monitored: time until hatching, growth and feeding. Comparing the results for time to hatch between salinization-impacted and non-impacted populations, differences were not found. For this endpoint, NaCl revealed to be more toxic than seawater (EC50 of 14.04 and EC50=11.89 mScm-1 for seawater and NaCl, respectively). As well, for the sub-lethally impacted endpoint (tadpole growth, weight and feeding) NaCl caused significant adverse effects. Highly diluted seawater increase growth on tadpoles from salinization-impacted population, but for non-impacted populations, tadpoles’ growth decrease with the decrease of seawater dilutions.

**MO059**
Wildfires effects on aquatic invertebrates organisms with in situ bioassays

N. Abrantes, University of Aveiro / CESAM/DAO; A. Ré, University of Aveiro / Department of Biology and CESAM; I. Campos, University of Aveiro / Department of Environment and CESAM; J. Pereira, University of Aveiro / Department of Environment and CESAM; J.J. Keizer, University of Aveiro / Department of Environment and Planning CESAM; F. Gonçalves, University of Aveiro / Department of Biology and CESAM

In the last decades, the increased frequency and extent of wildfires have become a societal and environmental problem in Portugal. Among the distinct environmental impacts, the role of wildfire on the water quality has increasingly received research attention. Differentially, in particular in the input of pollutants to the aquatic ecosystems, the hydrocarbons (PAHs) and metals associated to ashes. However, their toxic effects on the aquatic life have been largely ignored. The main goal of this study was to assess the off-site effects of wildfire on freshwater organisms through the use of in situ bioassays. These bioassays were conducted in a recently burned eucalyptus area located in Préstimo (Aguarda, central Portugal) and occurred after the first several fire rainfall events at four sites: U (upstream river) and SDS (stream upstream in the burned area), RUS (River upstream) and SDS (stream downstream in the burned area). Distinct freshwater organisms, including the shrimp *Aeacymphylia desmaresti* (water column organism), the amphipod *Echinogammarus meridionalis* (water-sediment interface organism) and the benthic insect larvae of *Chironomus riparius* were exposed in all four sites, using dedicated test chambers. After two days of field exposition, the mortality and post-exposure feeding inhibition were evaluated. The lethality was not sensitive to discern impacts among the assessed sites because the results showed negligible mortality for all the species and sites. Conversely, the sub-lethal post-exposure feeding inhibition, revealed a decrease in the feeding rate of organisms from the sites impacted by wildfire (RDS and SDS). Unlike, the sites outside the burnt area (RUS and SUS), showed no adverse effects in this endpoint. These results highlight that in situ bioassays are a suitable tool to assess the risks of wildfire to aquatic species and that the post-fire runoff, rich in substances such as PAHs and metals, can sub-lethally impair the aquatic organisms in water bodies located downstream the burnt area.

**MO060**
Estrogenic effects of an Organophosphorous Flame Retardant (TCPP) on Edible Seab Urchin "Paracentrotus lividus"

P.C. Lópe, University of Vigo / Ecology and Animal Biology; E. Pereira-Pinto, University of Basque Country; L. Mantilla-Aldana, University of Vigo / Ecology and Animal Biology; r. beiras, University of Vigo / Toralla marine sciences station (ecimat)

In the last decades, the increased frequency and extent of wildfires have become a societal and environmental problem in Portugal. Among the distinct environmental impacts, the role of wildfire on the water quality has increasingly received research attention. Differentially, in particular in the input of pollutants to the aquatic ecosystems, the hydrocarbons (PAHs) and metals associated to ashes. However, their toxic effects on the aquatic life have been largely ignored. The main goal of this study was to assess the off-site effects of wildfire on freshwater organisms through the use of in situ bioassays. These bioassays were conducted in a recently burned eucalyptus area located in Préstimo (Aguarda, central Portugal) and occurred after the first several fire rainfall events at four sites: U (upstream river) and SDS (stream upstream in the burned area), RUS (River upstream) and SDS (stream downstream in the burned area). Distinct freshwater organisms, including the shrimp *Aeacymphylia desmaresti* (water column organism), the amphipod *Echinogammarus meridionalis* (water-sediment interface organism) and the benthic insect larvae of *Chironomus riparius* were exposed in all four sites, using dedicated test chambers. After two days of field exposition, the mortality and post-exposure feeding inhibition were evaluated. The lethality was not sensitive to discern impacts among the assessed sites because the results showed negligible mortality for all the species and sites. Conversely, the sub-lethal post-exposure feeding inhibition, revealed a decrease in the feeding rate of organisms from the sites impacted by wildfire (RDS and SDS). Unlike, the sites outside the burnt area (RUS and SUS), showed no adverse effects in this endpoint. These results highlight that in situ bioassays are a suitable tool to assess the risks of wildfire to aquatic species and that the post-fire runoff, rich in substances such as PAHs and metals, can sub-lethally impair the aquatic organisms in water bodies located downstream the burnt area.
Abstracts New synthetic chemical compounds, like Organophosphorous Flame Retardants (OPFRs), are widely used by the industry as plastic additives in common life objects, or overlaying woods, fabrics, etc. They pose environmental risk due to their effects as androgenic or estrogenic endocrine disrupters, imitating male or female hormones respectively, interfering in vital functions of the organisms. Increasing presence of those chemicals in the water due to the incomplete elimination in the wastewater treatment plants, is emerging as a new problem in water contamination. OPFRs, like Tris (2-Chloro-1-Methylvinyl) Phosphate (TCP), are a typical flame retardant in plastics, being the most detected chemical in the aquatic system. Possible toxic effect of this chemical has not been deeply evaluated yet. This study aims to explore the possible effect of TCP as an endocrine disruptor on the edible sea urchin Paracentrotus lividus. 392 individuals having an average folial DNA damage. Behavioural Sponseres also examined, concerning activity and feeding behaviour. Overall, results provided insights into the effects of fluoxetine at the sub-individual and individual-level responses in this species and are discussed concerning realistic exposure scenarios as well as their potential implications to estuarine populations.

MO061 Short-term effects of fluoxetine exposure on biomarker and behavioural responses of an estuarine fish

L.A. Duarte, M.P. Pais, P. Reis Santos, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; V.F. Fonseca, MARE Marine and Environmental Sciences Centre Pharmaceutical compounds are routinely discharged into the aquatic environment. There is growing concern whether they elicit deleterious effects on aquatic organisms, following point source acute exposure as well as chronic exposure. Antioxidant enzymes (GST, MT2) have been detected in both freshwater and coastal systems and have deleterious biological effects at very low concentrations. Nonetheless, contradicting evidence has been reported with lack of consistency in responses across studies. In this context, short-term effects of fluoxetine exposure were analysed in common goby Pomatoschistus microps, an estuarine resident species. Two experiments were conducted: where 1) fish were exposed to environmental concentrations of fluoxetine for 96h (0.1 - 100 µg/L) and 2) fish were exposed to high fluoxetine concentrations for 1h (1.5 and 10 µg/L). Acute toxicity was assessed via multiple biomarker responses, namely antioxidant enzymes activity, detoxification enzymes activity, neurotoxicity and biomarkers of deleterious effects (e.g. catalase, glutathione S-transferase, acetylcholinesterase, lipid peroxidation). Behavioural responses also examined, concerning activity and feeding behaviour. Overall, results provided insights into the effects of fluoxetine at the sub-individual and individual-level responses in this species and are discussed concerning realistic exposure scenarios as well as their potential implications to estuarine populations.

MO062 Assessment of PCDD/Fs, dioxin-like PCBs and PBDEs in Mediterranean striped dolphins

F. Capanni, University of Trieste / Department of Life Sciences; J. Muñoz-Arganz, IQOQ-CSIC / Department of Instrumental Analysis and Environmental Chemistry; L. Marsili, M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environmental Chemistry; A. Bainy, Universidade Federal de Santa Catarina / Bioquimica; D. d’Araujo, Universidade Federal de Santa Catarina / Laboratorio de Bioquimica; J. Muñoz-Arganz, IQOQ-CSIC / Department of Instrumental Analysis and Environmental Chemistry Marine mammals are exposed to a variety of persistent organic pollutants (POPs) that bioaccumulate in marine ecosystems. In the present study, blubber samples from ten stranded Mediterranean striped dolphins (Stenella coeruleoalba) were used to investigate levels of polychlorinated dibenz-p-dioxins and furans (PCDD/Fs), dioxin-like polychlorinated biphenyls (DL-PCBs) and polybrominated diphenyl ethers (PBDEs) using gas chromatography coupled to a high-resolution mass spectrometer and by using the isotopic dilution technique. The WHO Toxicity Equivalence (TEQ) approach was applied. Median DL PCB concentration was 1820 ng/g lipid weight (Lw) (range: 474-3840 ng/g Lw), with males showing statistically higher concentrations. The mean value was 390 ng/g Lw (95% CI: 197-787 ng/g Lw). The most important contribution to the total TEQs (30.5%), followed by PCB126 (29.4%). The mean concentration values obtained were 6420 ng g⁻¹ (2100-20800 ng g⁻¹) for DL-PCBs, 612 ng g⁻¹ (312-1390 ng g⁻¹) for PBDEs and 57.8 pg g⁻¹ (45.8-83.5 pg g⁻¹) for PCDD/Fs. Quantification was carried out by the isotopic dilution technique by GC-HRMS on a Trace GC Ultra gas chromatograph coupled to a high-resolution mass spectrometer. Samples lipid content was determined gravimetrically. The relative abundance of the study contaminants followed the order DL-PCBs>PEBDEs>PCDD/Fs. The mean concentration values obtained were 6420 ng g⁻¹ (2100-20800 ng g⁻¹) for DL-PCBs, 612 ng g⁻¹ (312-1390 ng g⁻¹) for PBDEs and 57.8 pg g⁻¹ (45.8-83.5 pg g⁻¹) for PCDD/Fs.

MO063 Assessment of POPs in stranded sperm whales (Physeter macrocephalus) from the Mediterranean Sea

A. Bartalini, University of Siena / Department of Physical Sciences, Earth and Environmental Chemistry; J. Muñoz-Arganz, IQOQ-CSIC / Department of Instrumental Analysis and Environmental Chemistry; L. Marsili, University of Siena / Department of Physical Sciences, Earth and Environment; S. Mazzariol, University of Padova / Department of Public Health, Comparative Pathology and Veterinary Hygiene; G. Rossi, University of Siena / Department of Physical Sciences, Earth and Environment; B. Jimenez, IQOQ-CSIC / Department of Instrumental Analysis and Environmental Chemistry The sperm whale (Physeter macrocephalus) is a large toothed whale inhabiting the Mediterranean Sea. This endangered species is subject to a number of threats such as exposure to high levels of contaminants. Several studies show high levels of persistent organic pollutants (POPs) in dolphin tissues from the Mediterranean Sea, but data on sperm whales from the same area are much more scarce. In this study, we analysed POPs in blubber from 12 sperm whales from the Mediterranean Sea from 2009 to 2016. Fresh samples were spiked with a suit of PCDD/Fs, PCBs, and PBDEs 13C-labelled standards prior to Soxhlet extraction, and then cleaned-up by using the automated sample preparation system. Samples were analyzed for seventeen PCDD/Fs, twelve DL-PCBs and twenty-seven PBDEs. Quantification was carried out by the isotopic dilution technique by GC-HRMS on a Trace GC Ultra gas chromatograph coupled to a high-resolution mass spectrometer. Samples’ lipid content was determined gravimetrically. The relative abundance of the study contaminants followed the order DL-PCBs>PEBDEs>PCDD/Fs. The mean concentration values obtained were 6420 ng g⁻¹ (2100-20800 ng g⁻¹) for DL-PCBs, 612 ng g⁻¹ (312-1390 ng g⁻¹) for PBDEs and 57.8 pg g⁻¹ (45.8-83.5 pg g⁻¹) for PCDD/Fs. Our results indicate that the same species in the same area by a recent study from other authors save for PCDD/Fs which were found in an order of magnitude lower. Yet, they were generally much higher than those reported for sperm whales from the Sea of Cortez and from Australia. Regarding PBDEs levels, our results were lower than those reported for sperm whales from North-Atlantic. The PCDF congener profile in striped sperm whale (Physeter macrocephalus) was relatively similar to those reported for sperm whales from Australia and to those reported in blubber of striped dolphin (Stenella coeruleoalba) from the Mediterranean Sea. In contrast, the PCDD congener profile (hexa>penta> tetra>octa) was quite different from those with a lower contribution of higher chlorinated congeners and a higher contribution of lower chlorinated congeners. Total calculated TEQs ranged from 275 to 987 pg g⁻¹ Lw and surpassed the threshold of 210 ng g⁻¹ Lw, in bialopopulation as starting point of immunosuppression in harbour seals. This high level of contamination is not considered to be the cause of death of these animals, but may have contributed to lowering the defense of their immune system.

MO064 Biochemical and molecular responses to organic contaminants in bottlenose dolphins (Tursiops truncatus geoffroyi) from southern Brazil.

B. Righetti, Universidade Federal de Santa Catarina / NEPAQ-CCA; J.J. Mattos, Universidade Federal de Santa Catarina / NEPAQ, Departamento de Aquicultura; M.N. Siebert, Universidade Federal de Santa Catarina / LABCIA Bioquimica; D. Lima, Universidade Federal de Santa Catarina / Bioquimica; F.L. Zacchi, Universidade Federal de Santa Catarina / Departamento de Bioquimica; P. Frut, FURG Universidade Federal do Rio Grande / Museu Oceanográfico; F. Daura-Jorge, P.C. Simões-Lopes, Universidade Federal de Santa Catarina / ECZ; A. Bainy, Universidade Federal de Santa Catarina / Bioquimica; K. Luchmann, Santa Catarina State University / Engenharia de Pesca; V. Baracchi, Istituto Zooprofilattico Sperimentale Delle Venezie; R. Alves, Universidade Federal de Santa Catarina / LABCAI Bioquimica; D.d. Lopes, Universidade Federal de Santa Catarina / ECZ; A. Bainy, Universidade Federal de Santa Catarina / Bioquimica; K. Luchmann, Santa Catarina State University / Engenharia de Pesca. The present work evaluated biomarker response to persistent organic pollutants (POPs) in cetaceans. Such effects threaten the maintenance of cetacean populations, emphasizing the need for biomarkers that indicate early-on biological responses to POPs. The present work evaluated biomarker response to organic contaminants in bottlenose dolphins subspecies *geoffroyi* from two estuarine systems of southern Brazil impacted by agricultural and industrial runoff: Lagoa da Conceição Marine System (Santos Bay) (n=7) and Patos Lagoon Estuarine Complex (PLE) (n=10). Antioxidant enzymes and mRNA transcript levels of genes related to xenobiotic detoxification (*AhR, ARNT, CYP1A, GST, MT2*), antioxidant defense (*GST-π, GPx 4, GR) and immune response (*IL-1, MHCI-II*) were analyzed in integument samples obtained through remote biopsy. POPs were measured in the blubber of the same animals. Generalized linear models (GLMs) were used to analyze the response of each biomarker to PCBs, DDTs, Mirex, Chloroanines (CHL), Hexachlorobenzene (HCB), sampling season (winter or summer) and location (LES and PLE). The best model to describe each biomarker response, with the lowest Akaike Information Criterion (AIC), was chosen using backward selection. GLMs results indicate that...
the transcript levels of all studied genes were higher in winter when compared to summer, potentially due to enhanced metabolism over colder months. mRNA transcript levels of AHR, GR, IL1 and MT2 genes correlated positively with increasing levels of blubber ΣPCBs, supporting the occurrence of biological response to this class of contaminants. GLMs for MT2 indicated that the transcript levels of this gene are higher in dolphins from LES, possibly due to greater metal inputs in this area. GR activity was higher in dolphins with higher mercury levels. Overall, the findings indicate that the skin of bottlenose dolphins is altered due to exposure to ΣPCBs and ZPDEs, which co-varied with ΣPCBs, and Mirex. Absence of influence of other contaminant classes over biomarker response might be due to low contaminant levels in sampled dolphins. This might also have been overshadowed by the effects sampling season. Nonetheless, results indicate a sufficiently high exposure to PCBs. The authors hypothesise that the observed biomarker response implies a great area for future studies. An optimal study design combines the ‘extensive’ approach, by using chemically monitored individuals, together with chemical analysis of data derived from their natural habitats, could serve as a valuable tool for elucidating the possible treatment effects. The radiotagged white-fronted geese were then located bi-weekly. The results derived from the samples that were collected in May are indicative of the habitat quality at the species’ wintering and/or staging areas, while the ones derived from the samples collected in September are indicative of the habitat quality at the species’ breeding grounds. Moreover, in order to investigate the water quality in the breeding area of *F. eleonorae*, natural water pond samples were collected in September 2017 and further analyzed for the presence of heavy metals. Additionally, heavy metals were measured in liver of an individual found dead near the water ponds. According to the results, total plasma ChE activity ranged between 3.370±0.433 - 11.343±0.829 nmol ml⁻¹ min⁻¹ in May and 1.444±0.079 - 9.314±1.618 nmol ml⁻¹ min⁻¹ in September. AChE activity remained almost constant between the two sampling periods, while BChE in May was significantly higher than September. Total nuclear abnormalities showed almost similar frequencies in both periods, while cyttoplasmic abnormalities observed in September were significantly higher than in May. Cr and Cu levels in water samples were found to be within natural levels, while Cd and Pb concentrations were lower than the MAC-EQS values. All heavy metals were measured in liver and lung of individuals, captured and used as model species in un-polluted areas. The authors hypothesise that the observed biomarker response implies a great area for future studies. An optimal study design combines the ‘extensive’ approach, by using chemically monitored individuals, together with chemical analysis of data derived from their natural habitats, could serve as a valuable tool for elucidating the possible treatment effects. The radiotagged white-fronted geese were then located bi-weekly. The results derived from the samples that were collected in May are indicative of the habitat quality at the species’ wintering and/or staging areas, while the ones derived from the samples collected in September are indicative of the habitat quality at the species’ breeding grounds. Moreover, in order to investigate the water quality in the breeding area of *F. eleonorae*, natural water pond samples were collected in September 2017 and further analyzed for the presence of heavy metals. Additionally, heavy metals were measured in liver of an individual found dead near the water ponds. According to the results, total plasma ChE activity ranged between 3.370±0.433 - 11.343±0.829 nmol ml⁻¹ min⁻¹ in May and 1.444±0.079 - 9.314±1.618 nmol ml⁻¹ min⁻¹ in September. AChE activity remained almost constant between the two sampling periods, while BChE in May was significantly higher than September. Total nuclear abnormalities showed almost similar frequencies in both periods, while cyttoplasmic abnormalities observed in September were significantly higher than in May. Cr and Cu levels in water samples were found to be within natural levels, while Cd and Pb concentrations were lower than the MAC-EQS values. All heavy metals were measured in liver and lung of individuals, captured and used as model species in un-polluted areas. The authors hypothesise that the observed biomarker response implies a great area for future studies. An optimal study design combines the ‘extensive’ approach, by using chemically monitored individuals, together with chemical analysis of data derived from their natural habitats, could serve as a valuable tool for elucidating the quality of its foraging grounds and, hence the impact of land use on the species’ wintering and/or staging areas, wh
to ARs and integrated pest management (IPM). Broad concepts that emerged were: there is high conservation of the blood clotting process and so ARs can affect a wide range of non-target species; development of genetic resistance in target species led to global use of the more acutely toxic and persistent second-generation ARs (SGARs); vitamin K1 can be an effective antidote (unlike for many rodenticides); variation in non-target sensitivity may be due to pharmacokinetic, ecological and behavioural processes; >50% of predatory species contain AR residues; AR residues in secondary exposure to SGARs and of AR-induced mortality requires additional evidence (e.g., clinical signs, haemorrhagic lesions); probability of death in relation to AR residues may help assess extent of mortality in populations; tissue residues are informative of exposure but dietary AR concentrations are more suited to assess risk; and primary AR exposure associated with SGARs may be associated with risk to wildlife populations; knowledge of exposure and effects in invertebrates and lower vertebrates; enhancement of resistance management in target species; development of safe alternative chemical and non-chemical methods. It is anticipated that addressing these research priorities would reduce the potential AR-related conflict between protection of human health and wildlife.

Mo070

Anticoagulant rodenticides in red kites (Milvus milvus) in Britain


Second generation anticoagulant rodenticides (SGARs) can be toxic to all mammals and birds. Studies have shown that, in Britain, there is widespread exposure to SGARs in a diverse range of predatory mammals and birds, including red kites (Milvus milvus). This species may be particularly at risk as it scavenges dead rats, a target species for rodent control. Investigation of SGAR exposure in red kites is hindered by their independent lifestyle. This case may cause localized exposure to SGARs residues detected in 83 (34%) of the analysed red kites from England & Wales that were analysed, all had detectable residues of difenacoum and brodifacoum; most also contained bromadiolone. Difethialone was less frequently detected and flocoumafen was not detected in any birds. Sum liver SGAR concentrations ranged from 50 to 1266 ng/g wet wt. (arithmetic mean: 372 ng/g). Post-mortem examinations indicated that 9 (35%) of the kites had internal hemorrhaging that was associated with detectable trauma; most had elevated sums of SGAR liver concentrations. On the basis of these two factors, it is considered probable that SGARs were a contributory cause of death in these birds. Residue data were also available for 6 red kites from Scotland. Three (50%) had liver residues of at least two SGARs (bromadiolone and difenacoum); brodifacoum was also detected in one of these kites. SGARs were assessed to be a contributory cause of death in the bird that had residues of three SGARs. The data for Scotland, although limited, suggest that exposure of red kites in 2015 may have been less marked than in England & Wales, as has been found for other species collected in other years. Overall, these results suggest all red kites in England & Wales at least, are exposed to SGARs and that poisonings are not uncommon. Despite this, the red kite population has greatly expanded in Britain as birds recolonise former haunts. The entent to which exposure to SGARs may affect future population growth merits further investigation.

Mo071

Environmental determinants of the exposure to anticoagulant rodenticides in non-target species

J.J. López-Perea, Instituto de Investigación en Recursos Cinegeticos / Unidad de Ecología y Ciencia Animal; I.S. Sanchez- Barredo, UCLM-CSIC / Grupo de Toxicología de Fauna Silvestre; P.R. Camarero, Instituto de Investigación en Recursos Cinegeticos, CSIC-UCLM-JCCM / Grupo de Toxicología de Fauna Silvestre; R. Mateo, IREC-CSIC- UCLM / Grupo de Toxicología de Fauna Silvestre

Anticoagulant rodenticides have some similarities with other bioaccumulative persistent organic compounds, because of their frequent presence in many predatory species. In addition, the fact of being highly toxic substances makes this biaccumulation particularly harmful for these predators. Considering that the use of rodenticides occurs mainly in areas with high density of rodents that are in turn prey to multiple predators, we can also expect an ecological trap scenario. We studied the levels of second generation anticoagulant rodenticides (SGARs) and the environmental factors that influence such exposure in non-target species. The analysis included liver samples of wild animals (n=244) found dead between 2007 and 2016 in the region of Aragon (NE Spain). The sampling included 51 reptiles, 16 mammals and 32 birds. Liver samples were analysed by LC-MS and the presence of SGARs was statistically analysed with generalized linear models with a binary logistic response to study the effect of environmental or habitat characteristics including human population and landscape density and types and surface of crops. SGARs residues were detected in 33 (34%) of the analysed animals, corresponding to 25 (51%) species. Ten species (53 individuals) corresponded to four mammals and six birds, had residues >200 ng/g, which is the threshold associated with adverse effects: these included common raven (67%), red fox (50%), red kite (38%), eagle owl (25%), common buzzard (17%), Western marsh-harrier (17%) and Eurasian badger (14%). The spatial analysis at the municipality level has allowed to identify the percentage of urbanized urban land / Agricultural land / Forested area / Water / islands and urban core as descriptors of the presence of SGARs in animals. We have also discarded the relationship between the exposure to SGARs and the area occupied by cropland or intensive orchards. The presence of SGARs in predators was therefore more associated with the use of these products as biocides in urban areas or cattle farms rather than as plant protection products in cropland. This information could be used to identify the environmental and sociocultural factors that can act as an attractor and enhance the interaction of SGARs with non-tar

Mo072

Four years of NewRaptor: results from in ovo exposure in model species and field sampling in raptors

N. Briels, Norwegian University of Science and Technology / Biology; T.M. Ciesielski, Norwegian University of Science and Technology; M.E. Løseth, The Norwegian University of Science and Technology / Biology; B.M. Jenssen, Norwegian University of Science and Technology / Biology; I. Eulaers, University of Antwerp / Biology; C. Sonne, Aarhus University / Department of Biosciences; Arctic Research Centre; T. Nygår, T.V. Johnsen, Norwegian Institute for Nature Research NINA; P. Gómez-Ramírez, University of Murcia / Department of Toxicology; A. Garcia-Fernandez, University of Murcia / Sociosanitaries Sciences; J. Martínez, University of Murcia / Ecology and Hydrology; J.O. Busnes, Norwegian Institute for Nature Research NINA; G. Poma, G. Malarvannan, University of Antwerp / Evolutionary Genetics; A. Covaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; D. Herze, NILU Norwegian Institute for Air Research; B. Styrishave, University of Copenhagen / Section of Analytical Biosciences Department of Pharmacy; V. Jaspers, Norwegian University of Science and Technology / Biology

The international research project NewRaptor (ID 230465/F20, funded by the Norwegian Research Council and the Norwegian University of Science and Technology) aims to investigate the exposure and effects of emerging chemicals in birds of prey. The raptors under investigation include the terrestrial Northern goshawk (NG - Accipiter gentilis) and the marine White-tailed eagle (WTE - Haliaeetus albicilla) from Norway and NG from Spain. During the breeding seasons of 2015 and 2016, blood and body feathers were obtained from the chicks during the laying period (160 TE in Norway and 164 TE in Spain, with WTE were circa 4-9 weeks old). The samples were analysed for novel brominated flame retardants (nBFRs), organophosphate flame retardants (PFRs) and per- and polyfluoroalkyl substances (PFASs), along with trace elements and legacy persistent organic pollutants (POPs). Significant differences were found between the two species (with WTE generally showing higher levels of pollutants), but also within species, depending on the location. PFASs were generally found at the highest concentrations, with perfluorooctane sulfonate (PFOS) being the most important compound. nBFRs and PFRs were found at very low or non-detectable levels in blood plasma. Further, pollutant effects on different biochemical, immunological and endocrine parameters were assessed. We have performed controlled in ovo exposure studies in Japanese quail (Coturnix japonica) and common gull (Larus argentatus) as model species, both with single compounds and in a mixture scenario. The compounds for the quail exposure study included Dechlorane Plus (DP), tris(1,3-dichloro-2-propyl) phosphate (TDCIPP) and their 1:1 mixture, while PFOs, F-53B (PFOS replacement product) and their 1:1 mixture were used in chickens. Effects on gene expression and activity of anti-oxidative enzymes (catalase, superoxide dismutase, glutathione-S-transferase, alpha-1 antitrypsin and dipeptidylpeptidase-1, Gsh1, Gsh2, Gsh3, and Gsh4), protein oxidative damage and biotransformation (cytochrome P450A1) were investigated. Further, hormonal analysis of corticosterone and progesterone was performed using HPLC/MS/MS. Gene expression and enzyme assays on similar endpoints will be performed on NG samples in January 2018 and will be presented alongside the results from the in ovo exposure studies at SETAC. This will enable discussing the potential usefulness and pitfalls when extrapolating from laboratory dosing studies using model species to field assessments in raptors.
The potential of feathers as a biomonitoring tool for fluoxetine in wild birds

S.E. Whitlock, Environment Department, University of York / Environment; K. Arnold, University of York / Environment; J. Lane, Animal and Plant Health Agency; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; R. Shore, Centre for Ecology & Hydrology (NERC).

The antidepressant fluoxetine has been identified as a contaminant which may pose a risk to wild birds. However there is little empirical evidence regarding which bird species are most at risk of exposure to fluoxetine, in terms of concentration levels in wild bird samples. A significant barrier to sampling wild birds is that fluoxetine is cleared very quickly from systemic circulation and plasma concentrations might be expected to fall to levels below the limit of detection in less than one hour post-exposure. Faecal sampling presents a similar problem. However, fluoxetine is detectable in the hair of humans and other mammals. We hypothesised that fluoxetine might likewise be detectable in feathers. Moult occurs over a period ranging from weeks to months and during this time, growing feathers have a blood supply. If a wild bird was exposed to fluoxetine during this period, the compound could be laid down in the feathers and subsequently be detectable. We conducted an aviary study with wild caught Eurasian starling (Sturnus vulgaris) to determine whether fluoxetine administered during a period of feather regrowth is deposited in the feathers in detectable concentrations. We removed two rectrices (tail feathers) from each bird. We then administered a dose of fluoxetine at an environmentally relevant concentration (3.8 μg d−1) each weekday throughout the regrowth period. We plucked the new feathers once they were fully regrown and analysed them by LC/MS. For the untreated group, no major differences in size, weight, reproductivity or survival rates were determined and analysed using linear mixed models. Results of the study will be presented in detail in the poster. The results support the idea that feathers may have potential as tools for monitoring the occurrence and severity of exposure to fluoxetine in wild birds.

MO076
Different approaches comparison for evaluation of hypopharyngeal glands (HPG) effects in honeybees (Apis mellifera L.)


Honeybees (Apis mellifera L.) are beneficial arthropods that play important roles in natural ecosystems also in the food and pharmaceutical industries. One of the conditions for maintaining healthy colonies is the proper development of the honeybee workers hypopharyngeal glands (HPG) which produce proteinic substance to feed larvae and queen. The aim of this study was to validate the different algorithms (including obtaining the material) to conduct the hypopharyngeal glands development evaluation, in order to select the Method that combines the highest reliability (the smallest technical error), the optimal cost, the least effort and time-consumption. The study was conducted on Honeybees subjected to chronic toxicity studies performed according to the EFSAS guidelines (EFSAS Journal 2013;11(7):3295). Insects were treated with four different chemicals in 3 to 5 concentrations. The HPG were obtained from 3 bees per test item (in the highest concentration, which did not cause mortality below 50%) and the negative control. Six different approaches for HPG evaluation were tested: - histopathology (HP) of isolated glands (linear and quantitative measurements, imaging); - histopathology (HP) of whole heads (linear and quantitative measurements, imaging); - whole mount (WM) method on isolated gland (linear and quantitative measurements, imaging); - protein absorbance (PA) from isolated glands (quantitative measurements); - protein absorbance (PA) from whole heads (quantitative measurements); - scanning electron microscopy (SEM) (linear and quantitative measurements, imaging). The linear measurements (small and big axis of symmetry) were taken from ten acini from left and right HPG, however, for SEM only left HPG were included. The quantitative measurements (number of acini per 1 mm²) were taken during HP, WM and SEM testing. The quantitative measurements of protein absorbance from isolated glands were taken from left and right HPG and the analysis of the results showed decreases and increases of acini and protein absorbance depending on the test item. However, observed deviations did not show any statistical significance. According to the performed studies for evaluation of hypopharyngeal glands development the linear measurement combined with imaging should be used.

MO075
Monitoring NSAIDs in carrion and avian scavengers form Spain: preliminary results after diclofenac registration for veterinary use


3.2% of pigs (n=125) supplied in “muladares” situation generated in Asia. In the present study, it was examined if there were any residues of NSAIDs in carrion animals (kidney, liver and muscle of pig). After foliar spray application of a plant protection product on crops, food sources of small mammals may be potentially contaminated with this product. Ingestion of treated food could possibly lead to effects on the population level (e.g. reproductive impairment etc.). In the present study for evaluation of hypopharyngeal glands (HPG) effects in honeybees (Apis mellifera L.) are beneficial a...
Non-invasive assessment by feathers of lead exposure and its relationship with stress hormones in bearded vultures from the Alps

R. Mateo, IREC-CSIC- UCLM / Grupo de Toxicología de Fauna Silvestre; L. Giménez-Lozano, IREC Instituto de Investigación en Recursos Cinegéticos; L. Monclus, UAB; I. Chandly, ASTERS; M. Lopez-Bejar, UAB

A reintroduction project of bearded vulture or lammergeier (Gypaetus barbatus) has been carried out in the Alps since 1987. There are several factors that can affect the success of reintroduction programs and one of these factors is lead, a toxic metal that ends up in the blood of the bearded vulture used for hunting. An exposure to lead, even at sub-lethal levels, can be a stressful situation that implies an increase in circulating corticosterone levels. In birds that are rare and difficult to capture, blood sampling for both lead and corticosterone analysis can be a difficult task and with some risk for birds. For this reason, we selected feathers for being relatively non-invasive and to study exposure to pollutants and their respective biomarkers is being directed towards the analysis of easy-to-collect samples, such as feathers moulted by birds. The objectives of this study are to quantify the degree of exposure to lead that the bearded vultures have in the Alps by analysing moulted feathers found in the field, relating them to corticosterone levels in the same feather and defining the factors that affect the fluctuations of these two components along transverse segments of feathers. The analysis of the segments of 20 different feathers from different bearded vultures revealed that the abnormal exposure to lead (probably due to the ingestion of ammunition) had a prevalence of 15% (three feathers with levels above 2 μg/g of Pb in rachis), and that the annual incidence of such exposure was 30% (a feather with an abnormal exposure during its development of approximately two months). The current study is an extension of the previous study and focuses on the measurement of lead in feathers from a population in the Alps. The results of this study are important for the assessment of the degree of exposure to lead in bearded vultures and the use of feathers as a biomarker for lead exposure in birds.

MO081
Assignment of exposure and effects of Hg levels in feathers of White-tailed eagles (Haliaeetus albicilla) and Northern goshawks (Accipiter gentilis) nestlings from Norway

P. Gómez-Ramírez, University of Murcia / Department of Toxicology; J.O. Bustnes, Norwegian Institute for Nature Research / Fram Centre; G.S. Eggen, Norwegian University of Science and Technology / Biology; J. Elaurs, University of Antwerp / Biology; G. Lopes, University of Lisbon / Department of Oceanology; J.M. Pérez-García, University of Leida / Department of Animal Sciences; T.V. Johnsen, Norwegian Institute for Nature Research NINA; A. García-Fernandez, University of Murcia / Sociosanitary Sciences; V. Jaspers, Norwegian University of Science & Technology / Biology

Anthropogenic activities have led to a global increase of Mercury (Hg) in the environment. Due to its toxicological profile, regulatory measures have been taken to reduce the levels. To assess the effectiveness of such restrictions and the current levels of these chemicals in the environment, biomonitoring using birds is very useful. Hg has caused detrimental effects in birds such as haematotoxicity, immunotoxicity and endocrine disruption e.g. suppression of baseline corticosterone. The aim of this study was to assess the exposure to Hg and its effects at the biochemical/physiological and morphological levels in the nestlings of White-tailed eagles (H. albicilla - WTE) and Northern goshawks (A. gentilis - NG) from Norway. Samples were collected in 2014 from nestling WTE (n=14) and NG (n=11) in northern Norway (Norbord-N: 68.30 – 68.47; E 24.54 – 25.27°; Tromsø -55.78 to 67.39°; E 20.39 – 23.47°; counties respectively). Total Hg in feathers, total and free plasma corticosterone levels were assessed, along with following blood clinical chemical parameters (BCCPs): albumin, total protein, alkaline phosphatase, lactate dehydrogenase, total proteins, aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, cholesterol, triglycerides, creatine kinase, amylase, glucose, creatinine, bilirubin, potassium and uric acid. Stable carbon (13C) and nitrogen isotopes (15N, 14N) were analysed in blood plasma to evaluate inter- and intra-specific contaminant exposure. Due to the low amount of feather samples, Hg could only be analysed in 13 WTE and 8 NG. Mean ± SD were 0.51 ± 0.34 mg/kg in WTE and 0.68 ± 0.32 mg/kg in NG and 3.01 ± 1.34 μg/g in WTE. The significantly higher levels in WTE than in NG (T (y) = 7.61, p<0.01) may be related to different dietary input, as confirmed by stable carbon and nitrogen isotope analysis of body feathers. The marine origin of WTE seems to determine the Hg loads, as Hg is known to be abundant in the marine environment. By contrast, the levels found in NG are lower, according to the relations between Hg and other biochemical parameters (corticosterone, BCCPs) showed relations between Hg and aspartate aminotransferase (an enzyme that may increase after liver damage). The effect of mercury on this enzyme seems controversial, as some experimental studies on nestlings of different species have found both positive and negative relations. Moreover, the lack of information on reference values in GH and WTE complicates the interpretation. Acknowledgements: NILS Science and Sustainability.

MO082
Thyroid-related gene expression, hormones, and thyroid gland histology in American kestrels exposed in ovo to two persistent organic pollutants, SCCPs and TBPPA-BDBPE

A. MacLeod, University of Maryland, College Park / Environmental Science and Technology; P.F. Henry, U.S. Geological Survey / Patuxent Wildlife Research Center; K.J. Fernie, Environment & Climate Change Canada / Ecotoxicology and Wildlife Health; N.K. Karouna-Reiner, USGS Patuxent Wildlife Research Center /
Highly brominated flame retardants are being replaced by alternative flame retardants such as Tetrabromobisphenol A bis[2,3-dibromopropyl ether] (TBBPA-BDBPE). TBBPA-BDBPE was introduced as a possible substitute for decabromodiphenyl ether (decaBDE), but has shown similar persistence and environmental transport mechanisms. This additive flame retardant is used in plastic products, textiles, papers, and household electronics. Although it is produced only in the US, Israel, and China, TBBPA-BDBPE is detected in environmental samples and wildlife tissues from across the globe. Short-Chain Chlorinated Paraffins (SCCPs) are priority emerging persistent organic pollutants (POPs) identified as chemicals of concern by the Stockholm Convention, Environment and Climate Change Canada, and the U.S. Environmental Protection Agency. SCCPs are used in metal lubricants and coolants in metal cutting, and as plasticizers and flame retardants in plastics and paints. SCCPs are of concern because they bioaccumulate in wildlife and humans, are environmentally persistent, transported globally, and are toxic to aquatic organisms at low concentrations. However, few data are available on the potential adverse effects of TBBPA-BDBPE and SCCPs in birds. A comparative exposure assessment of these two classes of flame retardants was conducted using egg injections in a non-model species, the American kestrel (Falco sparverius) to assess survival, molecular, biochemical, and endocrine, growth and reproductive endpoints. Analyses conducted on tissue samples from hatchlings included thyroid related gene expression in the liver, thyroid hormone levels, and thyroid gland histology. Preliminary results will be presented from the molecular to biochemical to cellular level.

MO083 Bioaccumulation of metals in bats: non-lethal vs lethal sampling to assess risk J. Alves, R. Minua, A. Alves da Silva, C.FE - Centre for Functional Ecology, / Department of Life Sciences, University of Coimbra; T. NataI da Luta, University of Coimbra; J. Sousa, University of Coimbra; P. Barros, CITAB - Centre for Research and Technology of Agro-Environment and Biological Sciences / Laboratory of Applied Ecology, University of Trás-os-Montes e Alto Douro; C.J. Topping, Aarhus University / Department of Bioscience; J. Sousa, University of Coimbra / Department of Life Sciences

More than 22% of bat species are threatened according to the World Conservation Union. Among the reasons responsible for this decline are the environmental changes due to anthropogenic factors, namely habitat loss through agriculture, forestry, urbanization and industrialization, contamination by pesticides and metals, changes in water quality. There is a growing concern about the possible consequences of environmental contamination in several bat species. Until now, most of the studies on the effects of pollutants in bats are focused on non-model contaminants, and the consequences of exposure to other substances (particularly metals), remaining largely unknown. The aim of this study was to evaluate the potential risk of metal contamination in bat species occurring in Portugal, and to evaluate the suitability of non-lethal sampling methods. The concentration of As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Se and Zn was measured in two categories of biological samples: liver, heart, bone and brain; and non-lethal samples: wing membrane and fur) collected from bat carcasses of four different species (Hypsugo savi, Nyctalus leisleri, Pipistrellus pipistrellus, Pipistrellus pygmeus).

Concerning the metal contamination obtained in each sampling tissue, significant differences were found between the concentrations obtained in each species for all the metals (P ≤ 0.05), except for Zn (P=0.22). Significant differences were also found between the concentrations of metals (P< 0.001) in different organs and in different parts of the egg (i.e. content, membrane and shell). Samples from the Balearic Islands showed higher Hg concentrations (1.4 ± 1.2 mg/kg dm on dry weight basis) compared to other samples. Egg shells from marine environments (Corsica and Baleares) had five times greater [Hg] than those from wetlands. Egg content and membrane showed higher Hg concentration values than those of the shell. On the contrary, for Cd and Pb (though with minor differences) higher concentrations were found in the egg shell. Our study represents a first survey at regional scale and provides a first set of data for the long-term biomonitoring of heavy metals for the vulnerable populations of the Mediterranean basin in

MO084 Metallic element composition of egg contents and eggshells of the Kelp Gull Larus dominicanus J.D. van Aswegen, North West University (Potchefstroom Campus) / Unit for Environmental Science and Management; L. Nel, N. Strydom, Nelson Mandela University; H. Brown, North-West University / Unit for Environmental Science and Management

The Swartkops River Estuary near Port Elizabeth, South Africa, is an important recreational, industrial, residential, and ecological asset, but under severe pressure. Seabirds are good indicators of trace elements within their environments. Seabirds tend to feed at different trophic levels at different distances from the land and they are long-lived. Pollutants that have accumulated in the seabirds can be excreted in various ways from the body, one being deposition into eggs. Sixteen eggs of the Kelp Gull (Larus dominicanus) were analysed using ICP-MS (EPA 3050b method) for 30 trace elements, for both the contents and eggshells. We selected five elements (Cr, Sr, Tl, U, Zn) to compare and assess the absolute and relative compositional patterns in egg contents and shells. Mean concentrations for Cr in eggshells and egg contents were 3.8 and 18 mg/kg dm, for Sr it was 880 and 120 mg/kg dm, for Tl it was 0.00017 and 0.00022 mg/kg dm, for U it was 0.000057 and 0.000084 mg/kg dm, and for Zn it was 2.1 and 62 mg/kg dm, respectively. Of the five elements, only Sr (p = 0.0141) and Tl (p = 0.0013) concentrations showed significant positive regression between egg contents and eggshells. Chromium and Zn showed a positive regression but the regressions were not significant. Uranium also showed no association. The mean mercury concentration in the contents was 0.38 mg/kg dm, and the maximum was 2.1 mg/kg dm. The Toxic Reference Value for mercury in bird egg contents is 2 mg/kg dm, indicating concern about this element in the Swartkops River Estuary. Additional toxic implications, as well as comparisons with concentrations in other media will be discussed.

MO085 Heavy metals concentrations in Mediterranean Osprey eggs: variations by location, habitat and egg constituent part F. Monti, University of Siena / Department of Physical Sciences, Earth and Environment; University of Siena / Physical Sciences, Earth and Environment; A. Sforzi, Maremma Natural History Museum, Grosseto; N. Bianchi, University of Siena / Department of Physical, Earth and Environmental Sciences; C. Leonzio, University of Siena / Department of Physical Sciences, Earth and Environment

The osprey (Pandion haliaetus) has been historically used world-wide as a sentinel species for the biomonitoring of selected contaminants for aquatic ecosystems. In spite of this, occasional and fragmentary information are available for the species at the Mediterranean scale, where relic and vulnerable populations exist. In this study, we analyzed heavy metals concentrations in osprey eggs from three different populations of the Mediterranean basin (Corsica, Italy and Balearic Islands). In total, 21 unhatched eggs were collected, over a period spanning from 2005 to 2016. Moreover, Pb, Cd, Cdmium (Cd), and Pb (Pb) in these eggs were analysed with the aim to: (1) evaluate geographical patterns of for possible identification of inputs at the regional scale; 2) to evaluate differences in concentrations between samples from different habitats (marine environments and wetlands); and 3) to investigate any differences in concentrations among different parts of the egg (i.e. content, membrane and shell). Samples from the Balearic Islands showed higher Hg concentrations (1.4 ± 1.2 mg/kg dm on dry weight basis) compared to other samples. Egg shells from marine environments (Corsica and Baleares) had five times greater [Hg] than those from wetlands. Egg content and membrane showed higher Hg concentration values than those of the shell. On the contrary, for Cd and Pb (though with minor differences) higher concentrations were found in the egg shell. Our study represents a first survey at regional scale and provides a first set of data for the long-term biomonitoring of heavy metals for the vulnerable populations of the Mediterranean basin in

MO086 Interactive effects of vitamin E and BDE-47 yolk supplementation on morphological and oxidative status of yellow-legged gull embryos M. Parolini, University of Milan / Department of Environmental Science and Policy; C.D. Possenti, B. De Felice, Università degli Studi di Milano; N. Saino, University of Milano

Oviparous mothers transfer to the eggs contaminants that have both independent and combined effects on offspring phenotype. Functional interactions between egg contaminants, such as antioxidants and contaminants, may change the concentration of one component has effects on offspring traits that depend on the concentration of other interacting contaminants. However, the combined effects of variation in different egg components are virtually unknown. Bird eggs contain vitamin E (VE), a major antioxidant, and also a variable amount of maternally-transferred contaminants. Polybrominated diphenyl ethers (PBDEs) are a family of brominated flame retardants that have been widely used as non-negative additive compounds diverse commercial products. Many monitoring studies have revealed the presence of PBDEs in the biota, which can induce a plethora of adverse effects at different organisms’ life stages, often mediated by the onset of oxidative stress. Although PBDEs have been found in birds and their eggs, the consequences related to the exposure to these chemicals are generally inadequate. In addition, no study has considered that the oxidative stress-related toxicity of these compounds may be counteracted by the presence of antioxidant molecules that mothers allocate to their eggs at the time of laying. The independent consequences of variation in the egg concentrations of VE and PBDEs on offspring phenotype, including morphological and oxidative stress effects, are largely unknown, while no study has investigated their combined effects. Thus, we manipulated the concentration of VE and BDE-47, a PBDE congener having a well-known pro-oxidant activity, in the eggs of wild yellow-legged gull (Larus michahellis) by administering a physiological, large (2 standard deviations) dose of VE and 150 mg/yolk of BDE-47 both independently and in combination. We tested for effects on morphological traits (body mass, skeletal growth) and oxidative stress, as changes in total antioxidant capacity, amount of pro-oxidant species, antioxidant enzyme activity, lipid peroxidation, protein carbonylation and DNA fragmentation, in embryos soon before the hatching.
MO087
Sensitivity of freshwater pearl mussel juveniles (Margaritifera margaritifera) to different environmental and contamination factors

T. BELAMY, University of Bordeaux; A. LEGERAY, University of Bordeaux / UMR EPoC CNRS 5805; B. ETCHERRIJA, University of Bordeaux / UMR CNRS 5805 EPoC; M. Baudrinmont, Université de Bordeaux / UMR EPoC CNRS 5805

Margaritifera margaritifera is a freshwater bivalve mollusk threatened with extinction in Europe. The population of this freshwater pearl mussel has declined by 90% in Europe, during the XIXth century because of pearl fishing and from the XXth century due to habitat degradation, decrease in water quality and pollution. Nowadays, French population of *M. margaritifera* is estimated at 100,000 individuals with the largest population found in the river Dronne (Dordogne - FRANCE) with up to 15,000 individuals. Freshwater pearl mussels considered as an excellent indicator of aquatic ecosystem health since they require high water quality and they filter up to 50 L of water a day. As a result, they are called «umbrella species», meaning that their conservation will benefit all species living in the same river. With the aim of preserving this pearl mussel, the European project LIFE «Preservation of Margaritifera margaritifera and restoration of river continuity of the Upper Dronne river 2014-2020» has been set up in which a farm was created in order to produce juveniles in captivity. Some of them will be reintroduced into the environment while others will be used for ecotoxicological studies.

The aim of this work was to determine the sensitivity of *M. margaritifera* juveniles to different environmental and contamination factors, since they are considered as the most sensitive lifecycle of this species. Acute toxicity tests were carried out on one-year-old juveniles in order to determine toxicity thresholds (LC50) of several factors such as temperature, dissolved oxygen, nitrates, phosphates and metals. Those data will allow to target reintroduction areas of juveniles produced in the farm and help the conservation strategies of *Margaritifera margaritifera* in the Upper Dronne river.

MO088
Using population modelling to reduce uncertainty - an example of a herbicide

M. Wang, WSC Scientific GmbH / Dept Efa te Modelling; M. Fouadouakis, Dow AgroSciences / RSRA ERS

Uncertainty is perceived as a major acceptability criterion for higher tier risk assessment. While uncertainty does not start to be present at the higher tier (though it is generally not considered in the first tier) it needs to be addressed explicitly when higher tier refinements are applied which make the risk assessment more realistic. The use of standard higher tier refinements or even modelling is sometimes perceived as increasing uncertainty. However, in the present poster we demonstrate that refinements and population modelling help to reduce uncertainty by providing additional insights into the mechanistic understanding of risk and the ecological relevance of effects. This is done based on a risk assessment for a herbicide. It is shown how what-if questions help to address specific questions on uncertainty in the risk assessment and how a margin of safety can be calculated.

MO089
SETAC Wildlife Toxicology Interest Group

J.E. Elliott, Environment Canada / Science Technology Branch

LCIA method developments in a global perspective: Status and outlook (P)

MO090
A tool to integrate consumer and environmental exposure in life cycle impact assessment

O. Jolliet, University of Michigan; L. Huang, University of Michigan / Dept of Environmental Health Sciences; P. Funtke, Technical University of Denmark / Quantitative Sustainability Assessment Division

Direct exposure of consumers to chemical ingredients within our daily products is an important pathway that often dominates environmental performance profiles of these consumer products, but has been currently left aside in LCIA toxicity characterization. The aim of the present study is to update and extend the existing framework to consistently incorporate consumer exposure pathways in way fully compatible with existing LCIA toxicity characterization methods, and to illustrate it via a case study of plasticizer chemicals in building materials. We developed a general a framework and a tool that extends the toxicity assessment to the near-field and consumer exposure assessment and combines it consistently with the USEtox fate and exposure models. The chemical mass per functional unit in the consumer product is multiplied by the product intake fraction (PIF) to yields the total exposure expressed. The PIF represents the fraction of the chemical in products that is taken in by the consumer. It is determined by coupling fate processes in consumer environments (near-field) with existing environmental compartments and processes (far-field), via a consistent and mass balance-based set of transfer fractions. The developed tool already enables to calculate characterization factors for 22 types of building products, 8 types of personal care products, 7 contact food materials and multiple cleaning product-chemical combinations. The case study of DEHP plasticizer in a vinyl flooring shows that starting from a mass of DEHP in products of 82 kg, 0.15 kg will be taken in, mostly by the household users via dust ingestion as a dominant pathway. This leads to intake doses of 0.14 mg/kg bw-day for an adult and 0.5 mg/kg bw-day for a 3 years old child. Performing a full LCA of the vinyl flooring shows that the 16% of DEHP plasticizer in flooring are in average associated to dominant shares of impact on human health (56%) and (50%), while the remainder is a non-substitutable support for life that can be affected by both consumption (source function) and pollution (sink function). Therefore, both types of elementary flows (emissions and water consumption) should be linked to a damage indicator for...
freshwater as a resource. In order to clearly define what is to be protected, the freshwater resource is put in perspective through the lens of three safeguard subjects. Considering the current scope of the AoP natural resources, the complex nature of freshwater resources and the dimension of freshwater to safeguard, a definition of freshwater resource is proposed. Also, a wide range of possible impact pathways to freshwater resources is identified, establishing the link between different pathways to the environment that can determine their potential to cause freshwater depletion or pollution in the long-term. The concept of recovery period is used to operationalize this framework: when the recovery period lasts longer than a given period of time, impacts are considered as being irreversible and fall into the concern of freshwater resources protection (i.e. affecting future generations). The study shows that it seems relevant to include this concept in the impact assessment stage in order to discriminate the long-term from the short-term impacts, as some dynamic fate models already do. Recommendations are also given for freshwater resource impact indicator(s). Therefore, such an indicator would allow LCIA to capture potential long-term impacts that could transparently advise decision makers about potential safe water supply issues in the future.

**MO994**

### Considering water and soil conservation works in Life Cycle Assessment: focus on contour ridges and erosion impacts

**M. Jouini; Montpellier SupAgro / Département de génie rural; R. Campanini, IRD, UMR LISAH; S. Folkain, Montpellier SupAgro, UMR LISAH; J. Burte, CIRAD / UMR GEAU; N. Benaisa, National Agronomic Institute of Tunisia / Scie de la production agricole; S. Benaissa, Walloon Agricultural Research Centre; S. Belboom, ULiege; E. Pezennec, Knauf Insulation sprl.; Walloon Agricultural Research Centre; S. Belboom, ULiege; E. Pezennec, Knauf Insulation sprl.**

The purpose of this study is to compare side-by-side, the Hazard Factors (HF) of ProScale™ and the Effect Factors (EF) for human toxicity of USEtox™, and analyse the results, as both factors have been developed as a metric for adverse human health impacts due to toxic effects. Hazard factors in ProScale are derived based on substances classification in the GHS/CLP classification system, reflecting health effect severity based on H-phrases, whereas the USEtox based correction factor has been introduced to account for potency within each class. The effect factor (EF) is a metric of the change in life time disease probability due to change in life time intake of a pollutant (cases/kg). USEtox™ determines effect factors for carcinogenic and non-carcinogenic chemicals separately. Both methods have separate factors for inhalation and oral exposure. Therefore, increased use of LCA to support decisions related to chemical alternative assessments, characterization of the near-field exposures to these products is becoming recognized as increasingly important. Therefore, the US EPA has developed a research project to improve such characterization. Several recent papers have suggested that the exposures to these consumer products and building materials may be significantly greater than exposures to far-field emissions, and therefore, not including these exposures may result in decisions which are unknowingly biased in a manner which could lead to increased risk. The difficulty up to this point in time has been to characterize these exposures since the product compositions are often unknown and the pathways to exposure have been poorly characterized. This poster will describe the research and methods used to include the conceptual framework which demonstrates the methods by which the EPA intends to include exposures to these goods, the definition of Product Intake Fraction (PiF), the many exposure pathways being characterized, the methods for development of PiFs, and the data and models being recommended for a variety of populations to support this characterization. Finally, data gaps and other research needs will be discussed along with the future direction of the project. Key words: LCA, LCIA, impact assessment, building materials, exposure pathway characterization - This work was conducted under US EPA Contract No. EP-16-C-000070 with the University of Michigan. Disclaimer - The views expressed in this abstract are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

**MO999**

### Combined use of Mixed-Integer Optimisation and Thermodynamic, Molecular and Charge Density attributes for predicting Life Cycle Production

S. Garbient, Université de Liège / Chemical Engineering; F. van Stappen, CRAW Walloon Agricultural Research Centre; S. Belboom, ULiege; E. Pezennec, Knauf Insulation sprl.; S. Groselambert, University of Liège - Chemical Engineering / Dpt of Chemical Engineering - PEPS; A. Leonard, University of Liège

**MO097**

### Comparing ProScale Hazard Factors with USEtox Effect Factors for human toxicity

**T. Rydhberg; IVL Swedish Environmental Research Institute; H. Holmquist, Chalmers University of Technology**

The purpose of this study is to compare side-by-side, the Hazard Factors (HF) of ProScale™, and the Effect Factors (EF) for human toxicity of USEtox™, and analyse the results, as both factors have been developed as a metric for adverse human health impacts due to toxic effects. Hazard factors in ProScale are derived based on substances classification in the GHS/CLP classification system, reflecting health effect severity based on H-phrases, whereas the USEtox based correction factor has been introduced to account for potency within each class. The effect factor (EF) is a metric of the change in life time disease probability due to change in life time intake of a pollutant (cases/kg). USEtox™ determines effect factors for carcinogenic and non-carcinogenic chemicals separately. Both methods have separate factors for inhalation and oral exposure. Therefore, increased use of LCA to support decisions related to chemical alternative assessments, characterization of the near-field exposures to these products is becoming recognized as increasingly important. Therefore, the US EPA has developed a research project to improve such characterization. Several recent papers have suggested that the exposures to these consumer products and building materials may be significantly greater than exposures to far-field emissions, and therefore, not including these exposures may result in decisions which are unknowingly biased in a manner which could lead to increased risk. The difficulty up to this point in time has been to characterize these exposures since the product compositions are often unknown and the pathways to exposure have been poorly characterized. This poster will describe the research and methods used to include the conceptual framework which demonstrates the methods by which the EPA intends to include exposures to these goods, the definition of Product Intake Fraction (PiF), the many exposure pathways being characterized, the methods for development of PiFs, and the data and models being recommended for a variety of populations to support this characterization. Finally, data gaps and other research needs will be discussed along with the future direction of the project. Key words: LCA, LCIA, impact assessment, building materials, exposure pathway characterization - This work was conducted under US EPA Contract No. EP-16-C-000070 with the University of Michigan. Disclaimer - The views expressed in this abstract are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

**MO098**

### Integrating the Use Phase Impacts of Building Materials into Near-Field LCA Characterization

**L. Huang, University of Michigan / Dept of Environmental Health Sciences; N. Anastas, US Environmental Protection Agency / National Risk Management Research Laboratory; P. Egeghy, D. Vallerio, US Environmental Protection Agency / National Risk Management Research Laboratory; J.C. Bare, U.S. Environmental Protection Agency / National Risk Management Research Laboratory; O. Jolliet, University of Michigan**

Historically, LCA has focused on impacts with far-reaching temporal and spatial scales, and not exposures to near-field goods such as consumer products and building materials. However, with increased use of LCA to support decisions related to chemical alternative assessments, characterization of the near-field exposures to these products is becoming recognized as increasingly important. Therefore, the US EPA has developed a research project to improve such characterization. Several recent papers have suggested that the exposures to these consumer products and building materials may be significantly greater than exposures to far-field emissions, and therefore, not including these exposures may result in decisions which are unknowingly biased in a manner which could lead to increased risk. The difficulty up to this point in time has been to characterize these exposures since the product compositions are often unknown and the pathways to exposure have been poorly characterized. This poster will describe the research and methods used to include the conceptual framework which demonstrates the methods by which the EPA intends to include exposures to these goods, the definition of Product Intake Fraction (PiF), the many exposure pathways being characterized, the methods for development of PiFs, and the data and models being recommended for a variety of populations to support this characterization. Finally, data gaps and other research needs will be discussed along with the future direction of the project. Key words: LCA, LCIA, impact assessment, building materials, exposure pathway characterization - This work was conducted under US EPA Contract No. EP-16-C-000070 with the University of Michigan. Disclaimer - The views expressed in this abstract are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.
Impacts of Chemicals  R. Calvo-Serrano, G. Guíllén Gosalbez, Imperial College London / Chemical Engineering

Process sustainability has become one of the fundamental criteria for decision making in chemical industry, being Life Cycle Assessment (LCA) the most popular method in recent years, currently being one of the most extended sustainability assessment methods. Since LCA is based on the analysis of all interactions for all the stages of the life cycle, it ends requiring large amounts of information. This information, however, can be difficult or impossible to gather, being one of the main obstacles when trying to apply LCA. Chemical industry is particularly affected, easily having thousands of interactions even for small and relatively simple processes and only information of a few hundreds. In these cases, when a full LCA cannot be applied, a simplified version is used instead. These Streamlined LCA (SLCA) follow the same basis as LCA, but generally either simplify the scope of the analysis and/or reduce the amount of information required in the assessment. The precise simplifications to be done (and the assessment discrepancy with the full LCA) have to be specifically considered for the process or activity assessed. Under these principles, we present a novel approach for the estimation of LCA impact categories associated to the production of chemicals using information of their chemical and physical properties. We propose that the physical properties of the products are directly related with the impacts generated in the production process, and that these impacts heavily contribute to the overall impact generated for the production of the chemical analysed. Previous studies demonstrated the prediction capabilities of molecular and thermodynamic attributes. Here we also consider the ω-profile as attributes, for a better characterisation of the chemical and therefore to the generated impacts. In addition, we propose to reduce the whole assessment methodology to linear prediction models, selecting in each model only the attributes that better describe specific impact categories. This approach has been applied to a database consisting of 83 chemicals, considering 15 molecular descriptors, 17 thermodynamic attributes and 8 ω-profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP)(33.55%) or Eco-Indicator99 (EIP)(18.34%).

MO101  Development of USEtox characterisation factors for micropollutants in effluents

E. Maillard, ELSA-PACT Industrial Chair

Many substances are increasingly detected in surface waters, after their use by the human population. In most cases, these substances will exert the same effects as desired when they are originally applied, only now affecting different organisms. These effects can occur at concentrations of μg/l, which is why these substances are called micropollutants. In the context of Life Cycle Assessment, there is a need of characterising the toxicity potential of these micropollutants affecting ecosystems and/or the human population. A substance which is not characterised will not be considered in a LCA study, which may result in misguided decisions and the omission of essential environmental issues related to biodiversity and human health. The aim of this project is to develop a database of characterisation factors for the most chemicals as attributes, for the effluent of waste water treatment plants with the USEtox model. In order to develop this database, the following tasks are needed: identification of a priority list of substances currently missing in USEtox, while being highly relevant in the context of treated and untreated effluents; Literature review and database searches on existing data (required to calculate fate, exposure and effects) for the priority substances identified; Establishment of a database of newly developed characterisation factors for human toxicity and ecotoxicity impact potentials. All these newly developed characterisation factors will be submitted for inclusion to the official USEtox database center.

MO102  Advancing nutrient modelling in eutrophication methods for life cycle impact assessment


Anthropogenic contributions of the nutrients nitrogen (N) and phosphorus (P) threaten the health of freshwater and marine ecosystems around the world [1]. The increase in environmental nutrient availability, known as eutrophication, can lead to harmful algal blooms (HABs) and decreased levels of oxygen (hypoxia) needed to sustain aquatic life [2]. This presentation evaluates the current state of life cycle impact assessment (LCA) methods for eutrophication in freshwater and marine ecosystems using a criteria-matrix reviewed of the underlying fate and transport (F&T) models. Results of the review point to several key recommendations for further scientific development of mid-point eutrophication methods in life cycle assessment (LCA). Current eutrophication methods in LCA are limited. Most LCA studies use simplified F&T models with continental or global geospatial resolution, characteristics of which tend to be inadequate for regional analyses and complex community-based decisions. Therefore, this critical review examines a set of surface water quality models, watershed models, marine models, and air quality models that each have potential for integration into LCIA. Factors examined include sources of nutrient loading to each environmental compartment (e.g., water, soil), land use, and air), the forms of each nutrient modeled, and the representation of each F&T mechanism. Review results suggest several possible recommendations, including the continuation of the recent trend toward separation of freshwater and marine eutrophication methods, expanded characterization of the freshwater cause-effect chain, and the development of new soil and freshwater fate factors. By incorporating findings of the F&T models into current eutrophication methods, LCA can better inform scientific decisions that affect water quality, nutrient management, and environmental policies across watersheds and global ecosystems. [1] Rockström J, Steffen W, Neone K, Perrson Å, Chapin SF, Lamin EF, Lenton TM, Scheffer M, et al. 2009. A safe operating space for humanity. Nature 461: 472–475. [2] Diaz RJ, Rosenberg R. 2008. Spreading dead zones and giving up the sea. Science 319: 929-929. Disclaimer - The views expressed in this presentation reflect those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.
Damage Potential, Ecosystem Services Damage Potential, Biotic Natural Resource Depletion and Climate Change. However, only few of these impact pathways are fully implemented in currently available LCIA, also due to lack of significant consensus on this novel impact category. Specifically, LUC has to be carefully evaluated when assessing microalgae’s cultivation systems, as they may be strongly diverse one each other, hence impacting through diverse paths. Cultivation layouts may range, in fact, from large open ponds to more compact photobioreactors; they may be installed in natural environment, in freshwater ponds or offshore culture systems, either in brownfield lands in an optic of redevelopment of industrial areas, hence even generating a positive effect to the environment, mostly in terms of GHG’s fluxes and biodiversity. In this respect, the study aims at providing a consistent framework of the current methodology on LUC impact category and its application to bio-economy and, specifically, to microalgae’s production in order to provide support to business and policy decision making.

MO104 Application of LCIA water use methods to renewable energy systems in Spain

The topic of ‘water’ in LCA has emerged as an important approach to quantify the related effects of water use from consumption of goods and services. Several assessment methods have been proposed by the scientific community, encompassing both the computation of water use and its impacts, but differing in the way they define the water footprint (WF) of products and services. This work attempts to review and critically assess the methodologies to consider this impact category, this work presents the application of the most relevant methods for quantifying the water use in LCA of several renewable energy systems in Spain: 1) Water Footprint standard harmonized by means of ISO 14046, and ii) the AWARE method developed by WULCA working group (http://www.wula-waterlca.org), a midpoint water use indicator representing the relative Available Water (AW) remaining per area in a watershed.

MO105 Identification of methodological challenges remaining in the assessment of a water scarcity footprint
P. Quinteiro, University of A Coruña / Department of Environment and Planning; b. Biscaye, CSIRO; L. Arrojo, A. Dias, University of A Coruña / Department of Environment and Planning

Freshwater stress and its implications for present and human welfare and the natural environment awakened the need to develop spatially explicit methods to calculate the product water footprint (WF) from a life cycle perspective. In this sense two parallel developments emerged: a water footprint assessment (WFA) developed by the Water Footprint Network (WFN) to map direct and indirect water use along supply chains and its relevance in water resources management; and an impact-based WF following the life cycle assessment (LCA) methodology, according to the ISO 14046. Both WFN and LCA-oriented impact assessment methods considers blue water (fresh surface and groundwater) and green water (rainfall on land that does not run off or recharge the groundwater). After thorough comparative analysis of the diverse state-of-the-art of the methodologies to consider this impact category, this work presents the application of the most relevant methods for quantifying the water use in LCA of several renewable energy systems in Spain: 1) Water Footprint standard harmonized by means of ISO 14046, and ii) the AWARE method developed by WULCA working group (http://www.wula-waterlca.org), a midpoint water use indicator representing the relative Available Water (AW) remaining per area in a watershed.

MO106 Filling the Gap of Overfishing in LCIA: Eco-factors for Global Fish Resources
M. Stucki, Zurich University of Applied Sciences / Institute of Natural Resource Sciences; L. Eymann, ETHZ Swiss Federal Institute of Technology; B. Kelleher, R. Ien, Zurich University of Applied Sciences / Institute of Natural Resource Sciences

There is a lack of LCIA methods to assess the contribution of fish consumption to the global problem of overfishing. Due to this methodological gap, fish is often determined to have a lower environmental footprint than other sources of animal protein in LCA studies. The aim of this publication is to present the development of eco-factors for fish resources and by-catch as an addition to the Swiss Ecological Scarcity Method 2013 and to compare the eco-factors of different fish resources and the impacts of fishing as well as the impacts of dietary alternatives like chicken, pork, lamb, beef and veal. The sustainable use of fish resources ensures that the fish stock for each fish species exceeds the minimum stock needed for a sustainable yield. Therefore, the method developed uses a distance to target approach based on the fish stock for maximum sustainable yield (FSMSY) and the current fish stock (FS) for the characterisation of the use of fish resources. The eco-factors were calculated for each fish species and fishing area. The inclusion of the eco-factors shows the relevant contribution to the total environmental impact of fish compared to fishing and fish processing. Depending on the fish species, fish can have significantly higher overall impacts compared to different types of meat. The contribution of the eco-factors for by-catch is minor compared to fish resources but still relevant for the comparison with dietary alternatives. Distance to target based eco-factors using regionalised data for FS and FSMSY not only follow a comparable underlying approach as suggested in literature but also enable aggregation into a single-score with other environmental impacts. The overexploitation of fish resources is highly variable for different fish species and fishing areas as well as by-batch. When comparing fish to equivalent dietary alternatives like chicken, pork, lamb, beef or veal, consideration of the overexploitation of fish resources results in some fish species exceeding the environmental impact of dietary alternatives. Therefore, the overexploitation of fish resources is relevant in the Life Cycle Assessment of fish products in different diets. The state-of-the-art approach is limited to a full single-score LCA of meals and is able to reflect the regionalised impacts caused by the overexploitation of fish resources.

MO107 Constructing life cycle inventories for the hydroelectric sector in Peru: methodological considerations and environmental impacts
I. Vázquez-Rowe, Pontifical Catholic University of Peru / Civil Engineering Environmental Science; D. Verán-Leigh, Pontificia Universidad Católica del Peru / Civil Engineering Environmental Science

According to recent reports, hydropower currently accounts for 16% of worldwide electricity generation. Low carbon emissions are usually related to this source of energy, making it an attractive option for nations with hydropower potential to meet increasing electricity demand without relying on burning fossil fuels. However, the new wave of hydropower plant construction is occurring mainly in three tropical river basins: Amazon, Congo and Mekong; therefore, an additional environmental impact must be considered: biogenic greenhouse gas (GHG) emissions due to the resurrection of biotic natural resources. Peru is planning on installing up to 2,000 MW of installed capacity in hydropower until 2021, but the input and output flows, as well as the environmental impacts that these generate have not been explored. In this context, a set of three run-of-river hydropower plants built in the past decade located along the Peruvian Andes were analyzed from a life-cycle perspective. The main objective of the study was to construct detailed life cycle inventories for each of these three hydropower plants with the aim of having specific information for real conditions in Peru. This information was used to compute the environmental impacts linked to the generation of electricity at the plants. Although the main aim was to determine the GHG emissions linked to this process, considering the important policy implications of decarbonizing the Peruvian electricity grid, other environmental categories, such as eutrophication, acidification and climate change were also considered. The results computed show that GHG emissions per kWh of electricity produced were in the lower range of emissions observed in the literature, in all three cases below 3 g CO₂eq per kWh. Biogenic emissions represented less than 5% of the total GHG emissions despite their location in a tropical nation, due to the arid conditions of the landscape in the Highands, as well as the mild temperatures that are present in the reservoirs. Results intend to be of utility for an array of applications, including relevance in decision-making in the energy sector, policy-making at a national level, considering the implications in terms of meeting the Nationally-Determined Contributions to mitigate climate change in the frame of the Treaty of Paris, and for the international LCA community in an effort to expand the amount of inventories available for different geographical and technological conditions.

MO108 Global scale characterization factors for freshwater eutrophication from nitrogen and phosphorus emissions to water and soil
F. Martínez, Radboud University / Department of Environmental Science; A. Beusen, PBL; R. Van Zelm, Radboud University / Department of Environmental Science

Eutrophication is a key water quality issue triggered by increasing nitrogen (N) and phosphorus (P) levels and potentially posing risks to freshwater biota. In life cycle impact assessment, spatially explicit characterization factors (CFs) of phosphorus emissions to freshwater causing eutrophication have been derived. However, for nitrogen impacts, no efforts have been undertaken yet. Moreover, neither for agricultural emissions of N nor for N spatially explicit CFs have been derived. Therefore, the goal of this research was to determine spatially explicit CFs for...
freshwater eutrophication due to nitrogen as well as phosphorus emissions from wastewater treatment plants (WWTPs) and agriculture on the global scale. CFs were defined as the change in potentially not occurring fraction of species (PNOF) due to a change in the river basin-specific emission of P or N to freshwater (via WWTPs) or agricultural soil and consist of a fate and an effect factor. To determine the fate factors, the change in N and P concentrations resulting from agricultural as well as freshwater emissions year 2000 compared to year 1990 were separately modeled for every river basin in the world. Effect factors were based on log–logistic relationships between the PNOF (dimensionless) of heterotrophic species and total P (TP) or NO3 concentrations. The PNOF – concentration relationships were determined using data on the highest concentration where a species was observed in field surveys. Our work provides the opportunity to quantify worldwide spatially-explicit and time-dependent impacts due to nitrogen as well as phosphorus from soil as well as from freshwater emissions, in a coherent way. The factors can be applied to determine eutrophication impacts of products in LCIA, as well as to determine country-specific eutrophication footprints using multi-regional input-output (MROI) analysis.

Building of large-scale inventories of emissions and resources and applications for environmental footprints of territories, nations and sectors (P)

MO109 Carbon and material footprint of consumption in Flanders - an input-output based assessment A. Willekens, VITO NV; K. Boonen, M. Christis, VITO; E. Vander Putten, VMM-MIRA

Environmental footprints of a country or region are a measure for the environmental impact that is caused worldwide by national or regional consumption. The Flemish Environment Agency (VMM) asked VITO to assess the carbon and material footprint of consumption in Flanders (region of Belgium) and identify hot spots and bottlenecks. By using data on the Flemish environmentally extended input-output model. The Flemish EE-IO model is based on specific monetary and environmental data for the Flemish region of Belgium and is part of an interregional IO-model in which trade with the Brussels and Walloon Region is modelled in IO-tables. Imports from outside Belgium are included via the link with the use table of Exiobase. A monetary consumption matrix for households divides the final demand vector of households in different consumption categories. In 2010 the carbon footprint of Flanders amounted to about 20 tonnes per inhabitant. Nearly three quarters of the carbon footprint are linked to household consumption, mainly caused by the production and transport of the goods and services consumed. Three quarters of the carbon footprint of goods and services purchased by households are linked to housing, food and personal transport. Whilst the majority of the greenhouse gas emissions, primary materials and employment is outsourced, the added value linked to Flemish consumption is mainly created in Flanders. The presentation will introduce the overall results of the carbon and material footprint assessment of Flemish consumption in 2010 and go more in detail into the value chain impact of some household consumption activities e.g. food consumption. The relation between carbon and material footprint, geographical and sectoral distribution of different production chains and consumption activities, and the relation with added value and employment created by Flemish consumption will be discussed. As the model is available for 2003, 2007 and 2010, the evolution over these years will also be presented. Conclusions will mainly focus on methodological issues and policy implications that follow from this analysis. To achieve the greatest possible global environmental benefit, it is not enough to focus on a country or region’s boundaries alone. There is also a need for a policy that is aimed at making production chains and consumer behaviour more sustainable, including internationally harmonised calculation methods and targets of footprints to evaluate the results.

MO110 A cross-country analysis of relationship between economic structural change and CO2 emissions. K. Shiroinnita, Kyushu University / Economics; S. Kagawa, Kyushu University; Y. Kondo, Waseda University

In this study, we focus on the effects of changes in material and energy input structure on the life-cycle CO2 emissions (i.e., consumption-based emissions). Previous studies have employed a computational economic structural decomposition analysis including the shift toward a service economy and the increase in greenhouse gas (GHG) emissions embodied in consumptions of a specific country (United States or Japan) (Suh, 2006; Nansai et al., 2009). This study is an important follow-up research that examines the environmental effects across countries and evaluates whether or not the development levels of countries can explain those environmental effects. Specifically, we employed a multi-regional input-output structural decomposition analysis based on the World Input-Output Database (WIOD) during 1995 to 2008 (Dietzenbacher et al., 2013) and decomposed life-cycle CO2 emissions of 40 nations into the following four indument sources: (i) inputs from material goods (including energy) to material goods, (ii) inputs from material goods to services, (iii) inputs from services to material goods, and (iv) inputs from services to services. From the results, we found that the role of inputs from material goods to services and inputs from services to material goods in increasing life-cycle CO2 emissions have become more important than inputs from material goods to material goods in not only developed countries but also developing countries. Services are sustained by manufactured goods, so manufactured goods are necessary for the continued growth of service sectors. In a developed country, a large proportion of its GDP is generated by tertiary sector activities, and the role of service sectors in economic growth will expand more and more. In developing countries too, since the proportion of production from primary and secondary industries will shrink and that from tertiary industries will rise with their economic growth, the importance of service sectors will be enlarged. For this reason, it is essential to focus on the production systems of service sectors to reduce domestic CO2 emissions. It is especially important to shift to the industrial structure with less emission-intensive material goods.

MO111 Influence of substance coverage on impacts from the electricity sector A.S. Leclerc, DTU / Management Engineering; M.Z. Hauschild, Technical University of Denmark / DTU Management Engineering Division for Quantitative Sustainability Assessment; R. Wood, Norwegian University of Science and Technology / Biology; A. Laurent, DTU / Division for Quantitative Sustainability Assessment DTU Management Engineering

The electricity sector is a major source of emissions of greenhouse gas, but also heavy metals, dioxins or radioactive isotopes. However, most environmental assessments of the electricity sector at national or global scale focus solely on climate change and do not include other environmental impact categories such as particulate matter formation or toxic impacts on human health. At the national scale, few available databases are limited to a narrow substance coverage. For example, official reports of pollutants emissions to the European Monitoring and Evaluation Programme (EMEP) should cover 23 substances in 51 countries, but they are not always complete. The Multi-Regional Input-Output database EEMLSE includes emissions to air for 44 countries and 5 regions but only for 33 substances. In comparison, the database Ecoinvent provides emission data for hundreds of substances in the unit process inventories for electricity and heat generation. Here, we aim to develop a globally consistent and extensive database of airborne emissions from electricity production to get a more realistic coverage of toxicity impacts in large-scale life cycle assessment (LCAs). We thus built the Ecoinvent-based National Energy-related Emission Inventory (ENEII) by upscaling processes from Ecoinvent 3.3 with national production volumes of electricity and complementing it with emission data from external sources. The resulting inventory ENEII covers 229 substances, including 51 radioactive isotopes. By comparing inventories and databases at midpoint level, we showed that using Ecoinvent may underestimate the toxicity impacts associated with electricity production by a factor ranging from 1.4 to 1.9, while Ecoinvent may cut them off by up to 4 orders of magnitude in some countries. This demonstrates the importance of having an extensive substance coverage to fully represent the environmental impacts of electricity production.

MO113 Mapping the carbon, air pollution, and biodiversity footprints of nations: A GIS + global supply chains. K. Kanemoto, Shinshu University / Faculty of Economics and Law; D. Moran, Norwegian University of Science and Technology

"Spatial footprinting" is an approach for locating the actual hotspots where impacts due to consumption occur. As using Ecoinvent may underestimate the toxicity impacts associated with electricity production by a factor ranging from 1.4 to 1.9, while Ecoinvent may cut them off by up to 4 orders of magnitude in some countries. This demonstrates the importance of having an extensive substance coverage to fully represent the environmental impacts of electricity production.

MO114 LCA data machine applied A. Ciroth, GreenDelta; M. Stroeka, GreenDelta GmbH

In any LCA study, finding data sets that are “fit for purpose” is probably one of the aspects which consumes most time and effort, and the data sets which are used have obviously a direct implication on the stability of the result achieved. This high effort for finding and creating data sets is true despite the existence of several comprehensive, generic databases for LCA. It is underlined by the presence of intransparent, outdated, or out-of-region and context data set in these databases. For this reason, an “LCA data machine” has been developed at GreenDelta in the last 3 years, and was already presented earlier at conferences. The LCA data machine automatizes creation, update, and to some extent also review of data sets in LCA and sustainability assessment. Data sets are created to meet several specific requirements, e.g. related to region, time, or nomenclature system, but can also be

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created so that they meet requirement sets, such as, for example, related to PEF. Meanwhile, the “DAMA” has been applied to various sectors, products, and data sources. The presentation will summarise key steps of the development and will demonstrate the DAMA, for specific data sets and also for specific use cases. The LCA data machine will be demonstrated in three different application cases: 1) finding and if necessary creating data sets in situations where no data set is directly available, i.e. for data gaps; Paper machine example 2) creating a data set as copy of an existing document, to adapt to specific, local needs (creating soy bean production for India from soy bean production US 3) Product comparison, identification of differences between compared products The approach with DAMA will also be compared to approaches currently used in LCA, with examples from the PEF remodelling project and others. The LCA data machine has the potential to truly change the current approach for data set creation, exchange, and also use, in LCA and related areas and can be especially useful for creating inventories in a larger scale.

MO115 Static and dynamic modeling of high performance buildings: Comparison of average and marginal electricity mixes, a consequential effect on LCA results

M. Bilec, W. Collinge, University of Pittsburgh / Civil and Environmental Engineering; H. Rickenbacker, University of Pittsburgh / Civil & Environmental Engineering; A. Landsis, Clemson University / Environmental Engineering and Earth Sciences; C. Thiel, New York University School of Medicine / School of Public Health

This paper presents two types of models that can be used to represent buildings integrating electricity demand and production at the NZEB, and hourly or sub-hourly electrical energy usage data at a LEED Gold building: both are situated in an energy conservation district located in Pittsburgh, PA. Seven iterations of both static and dynamic life cycle assessment (LCA) based-models were performed and evaluated based on building energy use (predicted vs. observed), electrical grid time resolution (yearly, monthly, hourly) and region-specific electrical grids and data sources (Environmental Protection Agency, Department of Energy). Our results illustrate that the use of photovoltaics at the NZEB produced excess electricity by on-site renewables which is distributed back to the grid and can be interpreted as avoided upstream emissions (generation at the power plant), which in some cases may offset or enhance phase impacts. The marginal consequential model improved the payback period by an order of magnitude (12.5 years to 3.0 years). Additionally, the dynamic scenarios explored in this study were able to effectively account for the growth in natural gas generation, assigning or ignoring emissions based on a marginal increase or decrease load during the building’s energy use. The LEED Gold building is solely reliant on the regional electricity grid, making our findings indicative of a market-as-usual scenario and therefore comparable and/or scalable to other building studies. No studies comparing time-resolved building electrical usage with time-resolved grid electricity production have been found in a U.S. context. There are notable differences between the European and North American power grids, on that account this approach aids to the advancement of DLCA research domestically.

MO116 Life cycle framework for environmental assessment of public transport systems

A. Shinde, Indian Institute of Technology Bombay, Mumbai, India; A. Dikshit, Indian Institute of Technology Bombay, Mumbai, India / Centre for Environmental Science and Engineering (CESE); R. Singh, Thinkstep Sustainability Solutions Pvt. Ltd., Mumbai, India

Several studies have assessed life cycle environmental impact of public transport systems. However, there is no single platform, software or tool for comparing the energy and emissions from commuting purposes. The objective of this study was the development of an LCA based-framework to evaluate, analyze and compare the life cycle environmental impact of public transport systems. The modular and parameterized system of GaBi 6.5 platform has been used for exploring the life cycle environmental performance of commuting trains, public bus transport and intermediate public transport (IPT) modes viz. taxi, auto-rickshaw. The system boundaries comprised the environmental impact of construction and maintenance of transport infrastructure, manufacturing and maintenance of the vehicle, energy/fuel production and tail-pipe emissions. This framework is capable to characterize the per passenger km travelled (PKT) and vehicle km travelled (VKT) environmental impacts of an existing and proposed project. Since per PKT environmental impact of public transport systems are highly sensitive to ridership levels, the environmental impact of public transport systems and IPT modes has been compared for off-peak, average and peak hour levels of ridership. This framework has been developed on the basis of extensive data collected for the material and energy required for the construction and maintenance of infrastructure, manufacturing and maintenance of rolling stock, use phase impacts of fuel/energy production and tail-pipe emissions, in addition to the transport of raw materials. Therefore, this framework is highly comprehensive but it is also amenable to future additions and expansions. The regional transport authorities can proactively address the target areas for improving the environmental performance of their transportation system, and ultimately the competitiveness of their network. The regulatory authorities will have the information to improve on their policies to reduce environmental impacts associated with each mode at each stage.

MO117 Environmental impact assessment of rail freight intermodality in Belgium using the Life Cycle Assessment methodology

A.L. MERCHAN, University of Liege / Chemical Engineering, PEPs; S. Groslandert, University of Liege / Chemical Engineering; A. Léonard, Liège Université / Chemical Engineering - PEPs

BRAIN is a project supported by the Belgian Federal Government that deals with the possible development ofrail freight transport in Belgium, analysing the current situation of the intermodal rail freight transport from an interdisciplinary perspective. The objective of increasing the rail freight transport is linked to the European Commission’s White Paper on transport (2011), which aims to shift the 30% of road freight over 300 km to other modes of transport more energy-efficient such as rail or waterborne transport by 2030. In the framework of the BRAIN-TRAINS project, the Life Cycle Assessment (LCA) methodology has been chosen to analyse the environmental impact of the intermodal rail freight transport in Belgium. In a first stage we have carried out the LCA of rail freight transport (distinguishing between electric and diesel traction), inland waterways transport and road freight transport independently. In a second stage we have carried out a study of the environmental impacts related to intermodal rail freight transport. For this, we have studied several consolidated intermodal road-rail routes in Belgium. The aim of this analysis is to compare the environmental impacts of these intermodal routes depending on the freight transport mode chosen (rail or road transport) for the major part of the intermodal route. Finally, we have analysed how the increase of rail freight transport in the modal split as a result of the possible development of the intermodal rail freight transport affects the environmental impacts of inland freight transport in Belgium. For this, three divergent Belgian scenarios with a time frame set in the year 2030 have been studied for further analysis. These scenarios are directly linked to the third strategic goal of the European Commission’s White Paper on transport (2011). As a result, a best, worst and medium case scenarios have been developed, depending on whether the 30% shift will have been successfully accomplished, the status quo will have been maintained or the goal will not have been completely reached by 2030, respectively. The results obtained in this research will help initial planning and current theoretical modal split development in order to define the sustainability impact of future intermodal transport. They could help in making optimised policy decisions relative to the development of intermodal transport in Belgium, including environmental aspects and allowing the reduction of emissions in the transport sector.

Modelling and monitoring of pesticides fate and exposure in a regulatory context (P)

MO119 Quantifying visual assessment of kinetics - Development of an objective criterion to support visual assessment of SFO fits of parent soil degradation

J. Witt, Bayer AG / Environmental Safety; S. Boulke, Envisearch Ltd.; S. Ford, JSC International Limited; D. Patterson, Syngenta; B. Erzgraeber, BASF SE; M.A. Thomas, Monsanto Company; I. Hardy, Batelle; R.L. Jones, K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; J.A. Hinston, Chemicals Regulation Division

Kinetic evaluation of soil degradation studies for parent compounds is a key step to derive degradation endpoints. For modelling endpoints, single-first order (SFO) kinetics is preferred when acceptable, because it is implemented in exposure models. In presence of some bi-phasic tendency, acceptability of SFO is a recurrent source of discussions in the regulatory context. FOCUS kinetics guidance proposes Chi2err < 15% and visual assessment as decision criteria. However, the Chi2err method is misleading as it does not account for systematic deviations, while visual assessment is inherently subjective. In the framework of a group led by UK CRD, to update FOCUS kinetics guidance, we aimed at finding criteria to quantify visual assessment. We collected 40+ example soil degradation studies that were assessed separately by 4 experts based on visual assessment, using scores between 0 (clearly SFO) and 10 (clearly bi-phasic). Individual scores showed high variability, increasing the subjectivity of visual assessment. Based on group discussions, we derived group consensus scores. Consensus scores showed little correlation with Chi2err (R2 = 0.23). Among several proposed criteria, the SWARC (scaled and weighted area under the residue curve) criterion showed the best correlation to the consensus scores (R2 = 0.77). SWARC was specifically developed for this task. The residue curve is split into blocks of the same sign (i.e., over- or underestimating the residual data). Then the block areas are summed up, depending on the number of residues and summed up. The result is normalised by the study duration; a scaling factor accounts for high deviations from the last data.
point. Thus, the criterion mimicks the visual assessment process, taking into account the presence and size of systematic deviations, and whether the model adequately predicts the last data point, as a measure for extrapolation capacity. We find that SFO fits with SWARC < 40 can be considered clearly acceptable; for higher SWARC values, SFO may still be acceptable (particularly if SWARC < 65), but DFO should also be assessed. Testing of the criterion for metabolite fits showed that it was conservative and it could also be useful for metabolites. Taken together, we provide a novel tool that quantifies the visual assessment of SFO fits. This can guide decision making and thus help to reduce subjectivity in regulatory assessments.

MOI20 "Southside" - Bridging the hemispheres - Global use of field trials based on ecoregion similarities between New Zealand, Chile and Europe

B. Gottesbaeren, BASF SE / Crop Protection, Environmental Fate Modelling; H. Bayer, BASF SE; K. Platzer, BASF SE Agrarzentrum Limburgerhof / Environmental Fate Modelling; B. Erzgraeber, BASF SE; F.P. Donaldson, BASF Corporation / APD ERF; J. Goulet-Forint, BASF SA; F. Kröger, Eurofins Agroscience Services GmbH

In European regulations degradation rates in soil (DegT50) from terrestrial field dissipation studies TFD studies considered for exposure modeling may originate from "any" sites with soil and climatic conditions similar to Europe. An OECD Ecoregion similarity model (ENASIGPS) had been developed (OECD 2016) for gaining acceptance of field studies conducted in North America to Europe and vice versa. Ecoregions were identified between the New Zealand and Chilean sites and EU-NaFTA using the OECD ENASIGPS tool as well as an adapted GIS crosswalk with JRC-EFSA climate and soil maps for EU. The trial sites had soil types ranging from loamy sands, sandy loam, loam and silty loams. In New Zealand the sites were located on the Northern Island having an average annual air temperature of ~12-13°C and an average cumulative annual rainfall of ~780-970 mm. In Chile the sites were located in the Región del Bio-Bío east of Concepción having an average annual air temperature of ~14°C and an average cumulative annual rainfall of ~800-900 mm. The terrestrial field dissipation (TFD trials) were conducted according to OECD 232 (DegT50 module, soil covered with sand) with different pesticides at 3 sites in New Zealand and in Chile, having no historic use of these pesticides. All pesticides were applied in commercial formulation as a tank mix together in the same spraying on the same field plots at the same time. The field DegT50 were normalised to reference conditions (20°C, moisture p2) during kinetic analysis according to FOCUS, considering local soil conditions and weather data to estimate soil temperature and soil moisture with the PEARL model (as had been done with the EU studies). The quality indicator values of curve fit to data (Chi squared error) were judged to be acceptable. The normalized SFO DegT50 for the “Southside” trials in New Zealand were found to be in the range of those from TFD studies in Europe using the same study design.

MOI21 Residues of currently used pesticides in Central Europe arable soils: status quo, problems and consequences

J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX, P. Kosuobova, Central Institute for Supervising and Testing in Agriculture; S. Polakova, Central Institute for Supervising and Testing in Agriculture / Official control section; M. Hvezdova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); L. Brodsky, Charles University in Prague; J. Biedl, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); P. Dinisová, AQUATEST Inc.; Z. Simek, L. Skulcová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); M. Šedoma, Masaryk University / Faculty of Science, Masaryk University / Faculty of Science, RECETOX; M. Státková, Masaryk University / Central Institute for Supervising and Testing in Agriculture; M. Svobodová, L. Krkolová, J. Vasičkova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); N. Neuwirthová, Masaryk University

Current agricultural management is usually based on high consumption of pesticides which may bring a lot of environmental problems. Alarming results from monitoring pesticide residues in EU groundwater and surface water evoke the question of whether the arable soil can contain significant contamination as a result of the intensive use of pesticides in the present or past. Therefore, in 2014 - 2017, agricultural soil was monitored at more than 100 locations in the Czech Republic for more than 50 representatives of currently used pesticides, their selected transformation products and also banned atrazine and simazine with their transformation products. The results showed that the contamination of the monitored soils with the analysed pesticides is quite extensive. At least one pesticide exceeded the threshold of 0.01 mg/kg. The soils also frequently contained multiple residues: 85% soils contained 3 or more pesticides and 51% soils 5 or more pesticides. Over half the soils (53%) contained at least 2 pesticides exceeding 0.01 mg/kg. The most frequent compounds were triazine herbicides (present in 89% soils), which were also in significant concentrations (47% soils with triazine sum exceeding 0.01 mg/kg). Based on the association with the occurrence of terbutylazine and atrazine, it was considered that banned toxic simazine is still introduced significantly to the soils as an allowed impurity of massively applied terbutylazine. Persistent atrazine residues are still a legacy of the past, even over 10 years after its last use. The second most frequent compounds were conazole fungicides (present in 74% soils; 53% soils with conazole sum exceeding 0.01 mg/kg). Although no health or environmental risk analysis has yet been carried out on the data, the results draw attention for potential impacts, because: (a) foreign limits based on risk calculations have often been exceeded; (b) many of these substances are suspected carcinogens or endocrine disruptors; (c) substances occur in mixtures whose (eco)toxicity may be additive or even synergistic. The research was carried out with the support of the GACR project 15-20065S.

MOI22 Does the TOXSWA model simulate reliable concentrations in FOCUS surface water scenarios for a single segment water layer?

P.I. Adrianza, Alterra Wageningen University and Research Centre; W. Beltman, Alterra Wageningen UR

Current agricultural soil was monitored at more than 100 locations in the Czech Republic of the intensive use of pesticides in the present or past. At least one described transformation products and also banned atrazine and simazine with their transformation products. The results showed that the contamination of the monitored soils with the analysed pesticides is quite extensive. At least one pesticide exceeded the threshold of 0.01 mg/kg. The soils also frequently contained multiple residues: 85% soils contained 3 or more pesticides and 51% soils 5 or more pesticides. Over half the soils (53%) contained at least 2 pesticides exceeding 0.01 mg/kg. The most frequent compounds were triazine herbicides (present in 89% soils), which were also in significant concentrations (47% soils with triazine sum exceeding 0.01 mg/kg). Based on the association with the occurrence of terbutylazine and atrazine, it was considered that banned toxic simazine is still introduced significantly to the soils as an allowed impurity of massively applied terbutylazine. Persistent atrazine residues are still a legacy of the past, even over 10 years after its last use. The second most frequent compounds were conazole fungicides (present in 74% soils; 53% soils with conazole sum exceeding 0.01 mg/kg). Although no health or environmental risk analysis has yet been carried out on the data, the results draw attention for potential impacts, because: (a) foreign limits based on risk calculations have often been exceeded; (b) many of these substances are suspected carcinogens or endocrine disruptors; (c) substances occur in mixtures whose (eco)toxicity may be additive or even synergistic. The research was carried out with the support of the GACR project 15-20065S.

MOI23 Recent development of approaches for quantitative use of surface water monitoring data in aquatic exposure assessments

W. Chen, Syngenta Crop Protection, LLC; P. Mosquin, J. Aldworth, RTI International

Current pesticide regulatory ecological exposure assessments conducted by the U.S. Environmental Protection Agency are almost exclusively based on standard scenario computer modeling. Monitoring data may exist from targeted (prospective or retrospective) programs and for general water quality research by industry, governments, and academic organizations. However, use of the monitoring measured data has been limited in the regulatory assessment process to refine/inform modeling. The limited use of water monitoring data is largely due to variability in the monitoring program sampling designs (frequencies, timing etc.) and insufficient information regarding the exposure context and the context sensitivity of the vulnerability of the monitoring location to a broader regional extent. In this paper, we summarize a set of recently developed approaches to infer and quantify realistic pesticide exposure potential based on monitoring data, including bias factor (BF), universal kriging (UK), and survey statistics. These approaches can be used in a systematic way to provide a useful reality check for comparison with exposure model output in regulatory assessments, thus increasing confidence in decision making. Examples of applying these approaches are provided to demonstrate their usefulness for watershed scale assessments.

MOI24
Multi-year evaluations in the FOCUS Surface Water assessment - results of beta testing

D. Weber, M. Brauer, Eurofins Regulatory AG / Environmental and Ecological Modelling; A. Boleskan, Bayer AG, Research & Development, Crop Science; G. Spickermann, ADAMA Deutschland GmbH; D. Schaefer, Bayer Crop Science / Environmental Safety

The results of the predicted environmental concentrations (PEC) of active substances in surface water are based on a “single year” approach with an initial 6 year warm-up phase followed by 16 months of the year selected by the FOCUS group. Unlike in groundwater with a 20 years assessment period, surface water exposure calculations based on a “single year” approach can be strongly affected by individual rainfall events (EFSA, 2013) which was discussed repeatedly by authorities, industry and academia (Klein, 2013, Goerlitz, 2015; Bach et al., 2016, Poulsen, 2016). This presentation provides background on the technical methods and assumptions currently implemented into a software tool (Weber et al., 2017) that allows 20-year simulations of FOCUS surface water scenarios. In addition, results of a beta test including revealed technical issues, problems and assumptions are discussed. The software tool in its current state can easily be adapted to updated technical requirements or changes, i.e. any comments from official side (EFSA - FOCUS Repair Group) or from other sources can be addressed according to given consensus. The aim is to contribute to the development of an improved and generally accepted approach for surface water calculations representing a realistic worst case based on a robust evaluation. Bach M et al. (2016): Pesticide exposure assessment for surface waters in the EU. Part 1: Some comments on the current protection. Pvel. Nature Sci. Tech. 37: 172-178. (MKH code 153204) Multiyear FOCUS surface water modelling: Options and Proposals for Realisation. XV: Symposium in Pesticide Chemistry. Piacenza, Italy. September 2015 Klein M (2015): Long term surface water simulations using the FOCUS scenarios. Pesticide Behaviour in soils, Water and Air, York, UK. September 2013 Poulsen V (2016): Higher tier assessments of aquatic and terrestrial studies. AGCHEM Forum, Bamberg. September 2016 Weber et al. 2017: Multi-Year evaluations in the FOCUS Surface Water assessment. Conference Pesticide Behaviour in Soils, Water and Air, York 2017.

MO125 Spatial and temporal explicit catchment modelling in aquatic risk assessment using the modular framework CMF

S. Multsch, F. Krebs, S. Reichenberger, DR. KNOELL CONSULT GmbH; S. Heine, Bayer AG / Effect modelling; P. Kraft, L. Breuer, Justus Liebig University Giessen / Chair of Landscape, Water and Biogeochemical Cycles; T. Schad, Bayer AG / Environmental Modelling


MO126 Determination of runoff and drainage triggers for PEC surface water using automated simulation with FOCUS models

B. Kind, A. Guckland, J. Kleinmann, WS Consultants GmbH

For the zonal registration in the EU predicted environmental concentrations in surface water need to be simulated based on the FOCUS models. Three different entry paths are considered: runoff (simulated in PRZM), drainage (MACRO) and spray drift (SWASH drift calculator). While the latter only depends on the amount sprayed, the distance to the water body and the spray equipment used, runoff and drainage amounts are also triggered by substance properties, e.g. degradation in soil and adsorption to soil. Often, a lot of runs need to be simulated for different crops or application timings to proof a safe use of plant protection products as defined in the Good Agricultural Practice (GAP). For this poster we evaluate the FOCUS scenarios compared to the substance properties DT50 and Koc. The idea is to find DT50 and Koc values which trigger runoff and drainage specifically and to distinguish worst-case FOCUS scenarios for different DT50 and Koc values. Dummy substances will be created which have different values for Koc and/or DT50 in soil. The remaining properties will be identical for each DT50/Koc. Variation using automated FOCUS surface water simulations PECsw values were calculated for different crops at different application times within a specified year, e.g. spray drift as entry path to focus solemnly on drainage and runoff. The results for different Koc/DT50 values of a single scenario were compared to identify a trigger value for runoff or drainage in this scenario. Furthermore, the results of different scenarios for a single substance will be compared to find the most sensitive scenario for these Koc/DT50 values. Finally, the amount of simulations necessary to show a safe use might be reduced to certain worst-case scenarios depending on the DT50 and Koc properties of the substance.

MO127 Quantitative exploitation of passive sampler data for pesticide mass flow calculation in catchments and exposure risk evaluation

O. Galle, Luxembourg Institute of Science and Technology; M. Bayerle, D. Pittois, V. Huck, Luxembourg Institute of Science and Technology LIST

Pesticide monitoring remains the blind spot in WFD monitoring schemes because of the episodic occurrence of their emissions following application periods. Full coverage of relevant exposure periods is logistically impossible on a larger scale with classical monitoring methods like grab or automatic sampling. Passive sampling can provide a cost-effective solution that is independent of rainfall allowing thereby a good spatial resolution. However, passive sampling still suffers from a lack of confidence of regulators and investigators with regard to the reliability of the ambient concentrations it represents and the supposed variability of sampling rates in the field. This contribution will show a rational monitoring strategy that has been applied in several catchments in Luxembourg and validated with parallel auto-sampling of flood events during application periods. It establishes that passive sampling is essentially time proportional and that base- and high flows can be separated for their contribution in terms of time-weighted averages and event mean concentrations. The biases and uncertainties in terms of load calculations are addressed. Based on monitoring in different hydrogeological contexts the approach is meant to derive land and crop specific loads in catchments and exceedance probabilities of EQS values resulting in a risk map of impacted surface waters in Luxembourg.

MO128 Spatially distributed environmental fate modelling of terbuthylazine in a mesoscale agricultural catchment using passive sampler data

M. Gassmann, University of Kassel / Department Water Quality Management - Modelling and Simulation; T. Galle, Luxembourg Institute of Science and Technology; J. Farlin, Luxembourg Institute of Science and Technology LIST

The impact of agricultural practices on water pollution can be assessed by process-based reactive transport modelling using catchment scale models. Most models are limited to the application period, whereas it is necessary to assess potential residues that are transported to groundwater and surface water. The amount of residues is then used to derive load and crop specific loads in catchments and exceedance probabilities of EQS values resulting in a risk map of impacted surface waters in Luxembourg.
Pesticide losses via drainflow are strongly dependent on the soil moisture status at the time of application and the rainfall pattern that follows application. For drainflow simulations, the choice of application date can therefore have a significant influence on predicted environmental concentrations. To standardise the selection of application dates, the FOCUS surface water models include a calculator tool, the Pesticide Application Timer (FOCUS PAT), which selects an application date based on a window defined by the user by applying a set of rules to the daily rainfall data used in the simulation. Alternative criteria for selecting application dates for drainflow simulations were proposed by Brown et al. (2004; Pest Manag Sci. 2004 Aug; 60(8): 765-76), and incorporated into a modelling tool developed recently by the HSE’s Chemicals Regulation Division (CRD) for performing UK higher tier drainflow assessments using the MACRO model. Under these rules (referred to herein as CRD PAT) a different set of criteria is applied to the daily rainfall data, with the algorithm selecting the first compliant date on or after a particular target day. Both the FOCUS PAT and CRD PAT algorithms select pesticide application dates based on daily rainfall volumes. In practice, however, application dates can be constrained significantly by the trafficability of the soil. Product GAPs are designed to cover a wide range of application periods to account for seasonal variation, e.g., in dry springs applications might take place in March, while in wetter years, when it is more difficult to traffic wet soils, they may take place in April or even early May. When conducting multi-year modelling risk assessments this nuance is often lost from the risk assessment, and applications are forced into months when farmers would not have been able to travel their lands and apply crop protection products. Using a soil moisture deficit based approach to estimating the traffic PAT and FOCUS PAT CRD PAT is an attempt to capture these nuances in the trafficability of the soil. Product GAPs are designed to cover a wide range of application periods to account for seasonal variation, e.g., in dry springs applications might take place in March, while in wetter years, when it is more difficult to traffic wet soils, they may take place in April or even early May. When conducting multi-year modelling risk assessments this nuance is often lost from the risk assessment, and applications are forced into months when farmers would not have been able to travel their lands and apply crop protection products. Using a soil moisture deficit based approach to estimating the traffic PAT and FOCUS PAT is an attempt to capture these nuances in the trafficability of the soil.

MO129
Recalibration and cross-validation of pesticide trapping efficiency equations for vegetative filter strips (VFS) using additional experimental data

J. Carnall, G. Hughes, Cambridge Environmental Assessments; J.A. Hingston, J. Evans, Chemicals Regulation Division

Visualize and Assess: a tool for the pesticide risk mitigation in the surface and ground water compartments. The datasets to start with are the SARATOS/POCIS sampler data was helpful for verifying model setup of application field connectivity.

MO130
Vanda - Visualize and Assess: a tool for the pesticide risk mitigation in surface water

F. Galimberti, G. Azzimonti, ICPS International Centre for Pesticides and Health Risk; D. Prins, P. Dréano / Public Health; A. Moretto, Università degli Studi di Milano – The Directive 2009/128/CE of European Parliament and Council on Sustainable Use of Pesticides introduced a community action framework to protect the Environment of the EU and requested Member States to implement policies and actions in order to reduce the risk of pesticide use. In the Region of Lombardy, in Italy, this Directive was adopted with DGR n. X/3233. The aim of the present study was to improve the predictive capability of the Sabbagh et al. equation by broadening and refining the experimental data. For this purpose, additional experimental VFS datasets were compiled from the available literature and thoroughly checked for their suitability. Moreover, existing errors in the calibration and validation data points of Sabbagh et al. (2009) were corrected. The consolidated experimental dataset (n = 244) was used to recalibrate the Sabbagh and Chen equations. Moreover, a k-fold cross validation analysis was performed to assess the predictive capability of both models. The Sabbagh equation fitted the whole dataset slightly better than the Chen equation (r² = 0.82 vs. r² = 0.79) and performed consistently better in the cross-validation exercise (with respect to the prediction performance indicators Q², predictive r², and RMSEP). Finally, a maximum-likelihood-based calibration and uncertainty analysis were performed for the Sabbagh equation using the DREAM algorithm.

MO131
Selecting application dates for UK higher tier drainflow modelling: comparing the FOCUS PAT and CRD PAT rules, and assessing the role of soil trafficability

J. Carnall, G. Hughes, Cambridge Environmental Assessments; J.A. Hingston, J. Evans, Chemicals Regulation Division

The uncertainty of the tropical weather in the French Caribbean makes it particularly relevant to field sampling of chlordecone obsolete and new approaches should be explored to make the future model scenario. A theoretical study was carried out to assess the potential of passive samplers for the monitoring of chlordecone in French Caribbean rivers.

N. Tapie, Univ. Bordeaux, CNRS, EPOC UMR 5805 / EPOC UMR 5805; T. Rissler, Univ. Pau et des Pays Adour, CNRS / IPREM UMR 5254; A. Haouisse, Univ. des Antilles / UMR BOREA UA-CNRS7208-IRDR20-7667-MNHN-UPMC-UCN; P. Pardon, CNRS; P. Pardon, CNRS; P. Pardon, CNRS / EPOC Université Bordeaux / EPOC UMR 5805; B. Langue, Pau et des Pays Adour, CNRS / IPREM UMR 5254; D. Monti, Univ. des Antilles / UMR BOREA UA-CNRS7208-IRDR20-7667-MNHN-UPMC-UCN; T. Budzinski, Univ. Bordeaux

Recalibration and cross-validation of pesticide trapping efficiency equations for vegetative filter strips (VFS) using additional experimental data

S. Reichenberger, Modelling / GIS; R. Sur, Bayer AG

Vegetative filter strips (VFS) are widely used for mitigating pesticide inputs into surface waters via surface runoff and drainflow. To simulate and assess the performance of VFS in reducing surface runoff volumes, eroded sediment and pesticide loads the model VFMSOD (Muñoz-Carpena and Parsons, 2014) is frequently used. While VFMSOD simulates infiltration and sedimentation mechanistically, the reduction of pesticide load in surface runoff by the VFS (deltaP) is calculated with the empirical multiple regression equation of Sabbagh et al. (2009). This equation uses the following inputs: predicted reduction of total inflow (deltaQ) and eroded sediment load (deltaE), absolute surface runoff volume and eroded sediment load entering the VFS, linear adsorption coefficient Kd of the pesticide, and the clay content of the field soil (as a proxy for the clay content of the eroded sediment). The Sabbagh et al. (2009) equation, the coefficients of which were obtained by calibration against 47 data points, has not been widely accepted by regulatory authorities, on the grounds that its reliability has not been sufficiently established yet. Hence, evaluation against additional experimental data is necessary. Chen et al. (2016) proposed an alternative regression equation with a different structure based on 181 experimental data points. This equation uses fewer independent variables, but has more parameters than the Sabbagh equation. The objective of the present study was to improve the predictive capability of the Sabbagh et al. equation by broadening and refining the experimental data. For this purpose, additional experimental VFS datasets were compiled from the available literature and thoroughly checked for their suitability. Moreover, existing errors in the calibration and validation data points of Sabbagh et al. (2009) were corrected. The consolidated experimental dataset (n = 244) was used to recalibrate the Sabbagh and Chen equations. Moreover, a k-fold cross validation analysis was performed to assess the predictive capability of both models. The Sabbagh equation fitted the whole dataset slightly better than the Chen equation (r² = 0.82 vs. r² = 0.79) and performed consistently better in the cross-validation exercise (with respect to the prediction performance indicators Q², predictive r², and RMSEP). Finally, a maximum-likelihood-based calibration and uncertainty analysis were performed for the Sabbagh equation using the DREAM algorithm.

MO132
Considering diffuse urban and agricultural sources of pesticides at the landscape and catchment scale

G. Hughes, J. Camall, Cambridge Environmental Assessments; F. Ericher, CEA

For plant protection products (PPPs), there is a strong move towards landscape and catchment scale risk assessments as this allows for integrated risk assessments that consider multiple sources of pollutants, different exposure pathways as well as different receptors within a single framework. This landscape/catchment approach moves away from unrealistic worst case scenarios, designed to be protective of a wide range of usage situations, to a more realistic representation of usage environments that considers many different sources. Two important sources to be considered jointly within landscape and catchment scale risk assessments are pesticides residues emitted to surface water bodies and from urban and agricultural uses. At present these sources are risk-assessed using very different scenario-based approaches in isolation. Using a multi-disciplinary approach drawing on landscape implementations of the FOCUSssw scenarios to describe possible agricultural sources and an urban emission model to describe possible hard surface usage, this poster considers the likely magnitude and nature of these two sources of pesticide residues. The need for these two sources to be considered jointly within landscape and catchment scale risk assessments and the possible implications are discussed.

MO133
Calibration of passive samplers for the monitoring of chlordecone in French Caribbean rivers

N. Tapie, Univ. Bordeaux, CNRS, EPOC UMR 5805 / EPOC UMR 5805; T. Rissler, Univ. Pau et des Pays Adour, CNRS / IPREM UMR 5254; A. Haouisse, Univ. des Antilles / UMR BOREA UA-CNRS7208-IRDR20-7667-MNHN-UPMC-UCN; P. Pardon, CNRS; P. Pardon, CNRS / EPOC Université Bordeaux / EPOC UMR 5805; B. Langue, Pau et des Pays Adour, CNRS / IPREM UMR 5254; D. Monti, Univ. des Antilles / UMR BOREA UA-CNRS7208-IRDR20-7667-MNHN-UPMC-UCN; T. Budzinski, Univ. Bordeaux

For plant protection products (PPPs), there is a strong move towards landscape and catchment scale risk assessments as this allows for integrated risk assessments that consider multiple sources of pollutants, different exposure pathways as well as different receptors within a single framework. This landscape/catchment approach moves away from unrealistic worst case scenarios, designed to be protective of a wide range of usage situations, to a more realistic representation of usage environments that considers many different sources. Two important sources to be considered jointly within landscape and catchment scale risk assessments are pesticides residues emitted to surface water bodies and from urban and agricultural uses. At present these sources are risk-assessed using very different scenario-based approaches in isolation. Using a multi-disciplinary approach drawing on landscape implementations of the FOCUSssw scenarios to describe possible agricultural sources and an urban emission model to describe possible hard surface usage, this poster considers the likely magnitude and nature of these two sources of pesticide residues. The need for these two sources to be considered jointly within landscape and catchment scale risk assessments and the possible implications are discussed.
in the laboratory calibration (Rs=4.82 ± 1.93 L^-1). POCIS and POCISny samples can accumulate chloride efficiently despite its hydrophobic properties. POCIS 30µm seem to be a useful tool to monitor short flash floods, which happen regularly in this area.

MO134 Temporal patterns of pesticide residues in four major river basins in Korea

K. Kim, K. Son, Y. Ihm, H. Lee, National Institute of Agricultural Sciences / Department of Agro-food Safety & Crop Protection

To evaluate residues of environmental concerned pesticides which mainly include pesticides used for rice cultivation, total ninety four sampling sites were selected through main streams and branch streams of four major river basins. And the water samples were collected from these sites three times per year. From July-August, and September-October or November-December in 2012 and 2014. Besides, the water samples at sites of Keum, Mangyong and Dongjin rivers belong to the Keum river basin were regularly collected with a month interval, especially biweekly from May to August in 2013. Of the pesticides monitored, fenoxanil, hexaconazole, isoprothiolane, iprobenos and thifluazonamide as fungicides were mainly detected in rice season. While other fungicides including dimicazolon, propiconazole, fenamicon, nzmirul and bosalid, were detected with low frequencies and their average residue levels in positive samples were also fairly low. Of the insecticides monitored, some organophosphorus, cadusafos, diazinon, fenitrothion, fenithion, phenthoate and prothiophos, two carbamates, carbofuran and fenobucarb, and endosulfan were detected with low frequencies and low residue levels. Among herbicides, the most frequently detected pesticides in surface waters were atrazine reaching 107 ng L^-1 and malathion (10%), carbendazim (10%), atrazine (10%) and diuron (10%). For the groundwaters the most frequently detected pesticides in surface waters were atrazine reaching 2579 ng L^-1 and thiobencarb were detected with low residue levels for the rice plants and their residue levels were very low to compare with standard values.

MO135 Occurrence of 14 representative pesticides in surface and ground waters of the State of São Paulo, the biggest sugarcane producer in Brazil

R.D. Acayaba, SCHOOLS OF TECHNOLOGY UNICAMP; C. Raimundo, UNICAMP / Institute of Chemistry; A. de Albuquerque, G. umbuzeiro, School of Technology, UNICAMP / LAEG São Paulo State is the biggest sugarcane producer in Brazil and the second at pesticide consumption. The aim of this project was to develop a method to determine the presence of 14 pesticides representative from sugarcane plantation, 7 herbicides (simazine, atrazine, ametryn, clomazone, diuron, hexazinone and tebuhrion), 3 fungicides (azoxystrobin, carbadiazem and tebucconazole), 3 insecticides (carbofuran, imidacloprid and malathion) and 1 transformation product (atrazine-2-hydroxy) in surface and ground waters using liquid chromatography tandem-mass spectrometry (LC/ESI/MS/MS) and solid phase extraction as sample preparation. Limits of detection (LOD) and quantification (LOQ) were ranged from 0.9 to 22 ng L^-1 and from 2.5 to 74.5 ng L^-1, respectively. Almost, the mean recovery was 66 %, which allowed obtaining a sensitive and accurate method for the determination at trace levels. In total, 196 samples located in the main sugarcane area from São Paulo were analyzed (175 surface waters and 21 groundwaters) between October/2015 to October/2016. The most frequently detected pesticides in surface water were atrazine-2-hydroxy (100%), diuron (94%), carbadiazem (93%), tebuhrion (91%), hexazinone (91%), imidacloprid (96%) and ametryn (81%). The pesticide that presented the highest concentration for this matrix was imidacloprid, reaching 2579 ng L^-1. The risk to aquatic life were evaluated dividing the maximum environmental concentration of each pesticide by the lowest water quality criteria found in the literature. The potential risk for aquatic life was observed for imidacloprid, carbadiazem, atrazine and malathion. For the groundwaters the most frequently detected pesticides were atrazine-2-hydroxy (24%), imidacloprid (14%), carbadiazem (10%), tebuhrion (10%), atrazine (10%) and diuron (10%). The pesticide that presented the highest concentration for this matrix was tebuhrion, reaching 107 ng L^-1.

MO136 Exposure scenarios for aquatic risk assessment of pesticides in Brazil

B. Lena, BASF SE / Environmental Fate; R.P. SCORZA JUNIOR, Embrapa / EMBRAPA AGROPECUARIA OESTE; D. Máximo, R. Rebelo, IBAMA / DIQUA / CGASQ; A.V. Waichman, Universidade Federal do Amazonas; N. Peranginangin, Syngenta Crop Protection, LLC / Product Safety; A. Tornisielo, BASF SE / GENCS - E-Fate; L. Murakami, Bayer AG Crop Science Division; O. Perez-Ovilia, Bayer CropScience / Environmental Safety; E. Henry, Bayer / Environmental Safety; T. Haering, BASF SE

A tri-partite technical working group consisting of regulators, academia and industry was formed to develop a framework for aquatic risk assessment of pesticides in Brazil. The framework should include a sophisticated science based approach resulting in a comprehensive guidance. The basis of the exposure assessment is the selection of the 90th percentile vulnerability which is seen to represent a reasonable worst case and is used as basis of the exposure assessment in other parts of the world. Water surface waters should be identified in six pre-defined climatic zones for the seven most important crops soybean, maize, sugar cane, wheat, cotton, citrus and coffee. Runoff and spray drift were found to be the main entrance pathways of pesticides into surface water bodies. Whereas spray drift mainly depends on technology and local climatic conditions during application, surface runoff is influenced by pedoclimatic conditions that could be assessed in a spatial vulnerability analysis. For this the USDA Runoff Curve Number approach (RCN) which is implemented in PRZM was used. A simple model based on the equations of the RCN approach was developed to calculate daily surface water runoff volumes for the agricultural area of Brazil for 34 climatic years. Calculations were carried out on highest available resolution of soil data resulting in more than 63,000 raster cells. Hydrological soil groups were determined by using a Brazilian specific classification scheme applied to the national soil map. Relative vulnerability for pesticides was estimated with an integrated vulnerability index approach where indices for daily runoff such as average annual number of runoff events and average maximum runoff volume of each year were combined with an index for the expected substance concentration in the runoff water based on organic carbon content of the soil. The 90th percentile relative vulnerability was determined for the relevant crops for each climatic zone to select the relevant surface water scenarios. For the specific crop area, census data on municipality level were used first, but it was decided to switch to satellite images as far as they become available. After discussions in the technical working group the Brazilian environmental authority IBAMA decided to use the US-EPA PWC model for the surface water exposure assessment. Representative flowing and static water bodies which need to be natural and permanent will be defined for each selected scenario.

MO137 Identification of Herbicide Source Areas and Spatial Variability of Dominating Transport Processes in a High Agricultural Intensity Catchment

H. Rahin, M.F. Winchell, Stone Environmental, Inc / Environmental Systems Management; D. J. Sur, Bayer AG Crop Science Division / Sustainable Operations; F. Trebs, DR. KNOELL CONSULT GmbH; D. Lembich, Bayer AG Crop Science Division

The occurrence of herbicides in surface waters of intensively cultivated catchments can originate from a variety of sources. These include transport via runoff and erosion during storm events, subsurface transport through lateral flow and through subsurface tile drainages, and from spray drift during applications. The Soil and Water Assessment Tool (SWAT) is widely used in the United States and the EU for catchment scale hydrologic and water quality modeling of non-point source chemicals in the environment. The SWAT model was applied to a 992 ha agricultural catchment in the Flanders region of Belgium to help in better understanding the driving forces of the herbicide concentrations observed in daily sampling over 3.5 years at two locations along the catchment’s primary stream. The SWAT model was calibrated to observed flow and chemical monitoring data, then used to characterize the relative contributions of herbicides via surface processes, subsurface processes, and spray drift. In addition, very vulnerable fields with significant contributions to surface water exposure were identified. A quantitative comparison between monitoring data and simulated exposure profiles was made to single out those high residue concentrations that could not be attributed to any of these traditionally considered exposure pathways, and could ultimately be explained by point source contributions. The model results demonstrate that SWAT is capable of simulating streamflow in a small agricultural catchment, and is capable of simulating diffuse source pesticide concentrations. This allowed the calculation of an approximate relative importance of the three modeled transport pathways, distinguishing between diffuse source dominated high concentrations from those most likely affected by point sources. The SWAT model also proved useful in identifying the spatial variability in the dominant transport processes contributing pesticide residues to the stream. While surface runoff of soluble pesticide was the major non-point source contributor on most fields, lateral subsurface flow was found to be important as well, especially in the western portion of the catchment. Spray drift is likely the least significant contributor at the catchment scale. Overall, the analysis of monitoring data and modeling results shows that the potential for reducing herbicide concentrations in the study catchment can be addressed by mitigating both point source contributions from farmlands as well as diffuse sources.

MO138 Pesticides in water and surface sediments from Douro River estuary (Portugal) - assessment of environmentally relevant mixtures using acute toxicity bioassays

M. Maria Rocha, ICBCS U.Porto, CIMAR / CIMAR LA; C. Cruziero, CIMAR / CIMAR LA; Porto, CIF CCTUC U.Combra; S. Amaral, ICBCS U.Porto; E. Rocha, ICBCS U.Porto, CIMAR / CIMAR LA

The Douro River is an international water river that passes through extensive agricultural catchments, with national soil map determined by using a Brazilian specific classification scheme applied to the national soil map. Relative vulnerability for pesticides was estimated with an integrated vulnerability index approach where indices for daily runoff such as average annual number of runoff events and average maximum runoff volume of each year were combined with an index for the expected substance concentration in the runoff water based on organic carbon content of the soil. The 90th percentile relative vulnerability was determined for the relevant crops for each climatic zone to select the relevant surface water scenarios. For the specific crop area, census data on municipality level were used first, but it was decided to switch to satellite images as far as they become available. After discussions in the technical working group the Brazilian environmental authority IBAMA decided to use the US-EPA PWC model for the surface water exposure assessment. Representative flowing and static water bodies which need to be natural and permanent will be defined for each selected scenario.
MO139
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datasets were recommended. These recommended datasets, however, have been superseded by new datasets in the past few years. Specifically, daily weather and soils data have undergone significant updates, which are reflective of the considerable effort in Europe to update this spatial information. Not only does dataset choice, but also how datasets are being processed in a geographic information system, impact modelling results. Basic assumptions regarding aggregation of data, data slicing for determining climatic zones and data resolution impact our modelling results. In this poster, we will show the indications of data selection and data processing on a distributed modelling framework centered around GeoPEARL 4R. Specifically we will focus on differences between datasets, dataset set resolution, capturing variability and ones ability to model at the pan-European level within EFSA’s tier 3 guidelines.

MO144
Combining specific and public groundwater monitoring data as higher tier for pesticide regulatory risk assessment
A. Boivin, ANSES

Pesticides risk assessment for groundwater in France is performed according to Regulation 1107/2009. The European tolls are routinely used by considering the same models and same tiered approach. Groundwater monitoring data are identified as higher tier that may supersede modelling. Still, there is currently no agreed guidance available on the use of groundwater monitoring data for regulatory purposes. Work is ongoing on behalf the SETAC-EMAG GW group (www.setac.org/group/SEAGPest). The main issues when dealing with groundwater monitoring data are the need to start with a decision to use groundwater monitoring data, and then of how representative was the groundwater monitoring. In recent case, usefulness of the groundwater monitoring programs submitted at EU level as been questioned. Notably, the groundwater hydrology including its vulnerability and how representative / which situations the test sites might be considered to cover were not seen as not being properly addressed. Monitoring programs have also been submitted and assessed at national level mainly to refine metabolite groundwater risk assessment. Combined information from targeted and public monitoring were keys to address the representativeness of monitoring programs. The French groundwater public network (wells) is vast and the database is available online (www.ades.eaudefrance.fr). This database (ADES) is owned by the BRGM (French Geological Survey). This database mainly active substances, more metabolites will be included in the future Proposals to combine targeted together with public groundwater monitoring dataset were made to enhance the representativeness of the GW monitoring conducted.

MO145
Minimal variation in input parameters highly influences PEARL and PELMO results: how can these results be trustable?
S. Ullucci, ICPS; L. Menabballi, International Centre for Pesticides and Health Risk Prevention

The calculation of Predicted Environmental Concentration of pesticides in groundwater (PPECgw) is a crucial point in the risk assessment or authorization process of plant protection products (PPPs) in Europe. Calculations are usually performed by FOCUS models, in particular PEARL and PELMO models. These models allow a realistic but conservative assessment of the potential leaching of pesticides in the groundwater compartment. Model results are influenced by substance specific parameters such as DT50, KOM and Freundlich coefficient (1/n). Great variations in PPECgw values are expected when high variability occurs in one or more of the parameters listed above. In this work, we demonstrate that PECgw outputs are significantly affected also by minimal variation of the same parameters. Considering that a minimal variation is intrinsic in all laboratory studies (es. 25% uncertainty in KOM determination was calculated applying the Horwitz equation), it is questionable whether a corresponding high variation in model is scientifically acceptable. In a previous project (York, 2017), dummy substances with different combinations of DT50, KOM and 1/n values were used in FOCUS PEARL, in order to quantify the influence of each single parameter on the final PECgw. It was verified that the sensitivity of PEARL model can be considered quite excessive. In this follow-up project, further calculations were performed using FOCUS PELMO to consider the sensitivity of these two models, commonly used in a regulatory contest. Leachate concentrations were plotted as a function of KOM and as a function of degradation rate coefficient, PECgw obtained by the simulations of these two models were used to create a classification system for the input parameters KOM and DT50 according to models sensitivity. Conservative values for each parameter class, to be used in PEC gw calculations, are proposed for all substances. This approach can minimise the effects of the intrinsic input variability providing a better scientific approach to the assessment of groundwater modelling in the regulatory context.

MO146
European regulatory network on pesticide groundwater monitoring
A. Gimnás, The Danish Environmental Protection Agency / Pesticides and Gentecology; W. Koenig, UBA Umweltbundesamt; A. Boivin, ANSES; A. Poot, Cgb.; A. Schwem, AGES; M.E. Balmer, Plant Protection Chemistry; A. Massey, Chemicals Regulation Directorate; W. Tütting, German Federal Office of Consumer Protection and Food Safety

Groundwater monitoring data should be included in the assessment of the leaching risk of pesticides and their metabolites. Monitoring data is generated in most European countries, but their use for leaching risk assessment during pesticide authorization is hampered due to the following reasons: (i) The data is often not publically available or available only in an aggregated form in a report, (ii) most groundwater monitoring data is not available in the national language of the origin country, which makes it hard for other countries to interpret and (iii) the interpretation of data monitoring requires detailed knowledge of the local geological, hydrological and climatic conditions, and also knowledge about crops and the use pattern for pesticides. To overcome these difficulties, a network among regulatory authorities in Europe involved in groundwater risk assessment of pesticides is proposed. The aim of this network is to exchange pesticide groundwater monitoring data and frequent updates about the focus of national monitoring, and to assist each other in the interpretation of the data. The network plans to have its first meeting in Copenhagen, Denmark, in September 2018 with an invitation to all interested European countries to participate. The poster will present the thoughts about the network and the status of the start-up, and aims at promoting the network to interested authorities.

MO147
Overview of measured wash-off factors from experiments suitable to derive a refined input for FOCUS modelling
G. Reinken, E. Hellpointner, Bayer AG, Research & Development, Crop Science / Environmental Safety; D. Sossiaux, Bayer Crop Science / Environmental Safety

Recent regulatory interest in the wash-off process resulted in a proposal to that the effects of wash-off should be considered as additional soil loading for FOCUS modelling of foliar applied pesticides (EFSA 2010, 2016). EFSA also proposed to increase the default wash-off factor for FOCUS modelling from 0.5 cm-1 to 1 cm-1 (EFSA 2012). On the other side, ESA has stated that effects of wash-off should be not considered at all. Supplementarily wash-off factors are normally distributed. The arithmetic mean of all single values is 0.38 cm-1 with a median of 0.40 cm-1. Just 7 of the 25 values are slightly above the existing default wash-off factor of 0.5 cm-1. The highest measured wash-off factor is 0.57 cm-1 and the lowest 0.14 cm-1. A wash-off factor of 1.00 cm-1 would be clearly outside the 3 sigma range of the experimental data set. This experimental evidence does not support the proposal to increase the existing default wash-off factor from 0.5 cm-1 to 1 cm-1.


MO148
Leaching and plant uptake of trifluoroacetic acid (TFA) under cropped outdoor conditions
G. Reinken, M. Beckmann, Bayer AG, Research & Development, Crop Science / Environmental Safety; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; U. Kölzer, Bayer AG, Research & Development, Crop Science / Environmental Safety; M. Lamsoefy, Bayer CropScience AG / R&D; S. Sittig, DR. KNOELL CONSULT GmbH / E-Fate Modelling

In recent regulatory discussions about the plant uptake process the question was raised if tracer-like substances (very low or zero sorption, very slow or no degradation) are fully available for uptake by plant roots under dynamic outdoor conditions. In an alternative hypothesis it is that such substances move so quickly in the soil column that they are taken up by plant roots to a lower extent than indicated by static laboratory plant uptake studies. To address this particular question an outdoor container study was conducted with 14C-labeled trifluoroacetic acid (TFA) and winter wheat plants for a time period of 228 days after application onto soil. Trifluoroacetic acid is a common breakdown product of several chemical products e.g. HTS chemicals (used mainly in medicine e.g. pharmaceuticals, pesticides, pyrolysis of PTFE (used as coating in many products like Teflon® or GORE-TEX®). Plant root uptake of TFA under static conditions has been determined in parallel with experiments using plants growing in nutrient solution (hydroponic study design). The translocation and uptake of trifluoroacetic acid observed in the outdoor container study was evaluated with the PEARL model considering root uptake processes as routinely applied in standard FOCUS modelling. A transpiration stream concentration factor (TSCF) for TFA under cereal growing outdoor conditions could be derived. The results demonstrate that mobile, tracer-like substances are taken up extensively by plant roots even

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under dynamic outdoor conditions; the hydroponic study design is suitable to determine conservative input parameters for regulatory modelling; uptake experiments with cropped outdoor container may be suitable as higher-tier to derive a refined TSCF. Further experiments will indicate to which extent this study design is also suitable to derive refined TSCF for compounds with other sorption and degradation properties.

MO149 Investigating the variance of edge-of-field deposits of spray drift
H. Holterman, Wageningen University & Research / Agrosystems Research; J. Van de Zande, Wageningen University and Research / Agrosystems Research

Spray applications in arable crops often lead to off-target spray deposits downwind from the treated field. Throughout several decades, many experiments have been carried out by different researchers to quantify the downwind spray deposits. Relations between downwind spray deposits and parameters like sprayer settings, field conditions and environmental conditions were investigated. Still, there is a large variance in the observed data that cannot be explained satisfactorily by the experimental and environmental conditions. Spray droplet movements and local fluctuations in driving speed, wind speed and wind direction are the most likely factors affecting variance in downwind spray deposits. In this study variations in downwind deposits of spray drift caused by spray boom movements are investigated both experimentally and on simulations using the spray drift model IDEFICS. Downwind deposits of spray drift were measured alongside a treatment vertical profile at 0 m and 5 m downwind from the treated field. The part of spray deposit that is captured by a canopy of trees is recorded during the experiments. Horizontal and vertical movements of the spray boom were recorded as well. Variance of spray deposits at 2 m downwind from the field edge was about 50%. At 5 m downwind variance was about 30%. A quasi-dynamic model was developed based on the IDEFICS spray drift model. In the new model the effect of both horizontal and vertical boom movements on downwind spray drifts was studied. From the above mentioned experiments, the most important frequencies and amplitudes of boom movements were derived. Using these frequencies, the model simulations resulted in variances of spray drift deposits similar to those established experimentally. Effects of fluctuating wind directions are to be investigated in the near future.

MO150 Exposure assessment for edge-of-field watercourses next to tree nurseries regarding spray drift deposits
H. Holterman, Wageningen University & Research / Agrosystems Research; J. Van de Zande, Wageningen University and Research / Agrosystems Research

In the Netherlands admittance 90,000 live within 50 m of flower bulb or fruit cultivation. It is unclear how many of these people are exposed to pesticides or whether their health is at risk. Recently, a research project was launched to assess the exposure of residents to pesticides next to flower bulbs fields. This research projects involves both measurements and simulations of airborne spray drift. Volatilization is investigated for several days after spray application. Outdoor and indoor air samples are collected in areas with and without trees. Inhalation exposure is calculated in combination with the exposures to spray drift only. After application using a conventional boom sprayer ground deposits and airborne distributions of spray drift are measured down to 50 m from the treated area. Airborne spray drift is measured up to 10 m height, using two different sampling techniques. At 50 m downwind, airborne spray drift appears to be up to 100 times higher than ground deposits. Simulations of spray drift are studied using the IDEFICS spray drift model for boom sprayers. The project results show downwind ground deposits and airborne spray drift with values in the same order of magnitude as those found in the experiments. The results indicate that potential exposure of residents to pesticides used when treating nearby fields may be significant and further assessment of this exposure route is important.

P. Adrian, M. Liegeois, M. Darriet, B. Jouanol, CEHTRA SAS

There is no recent or relevant guidance on how to conduct a risk assessment for consumers for co formulators present in plant protection products. One of the reasons is the lack of exposure data when the product containing its co formulators is applied onto crops. To our knowledge only one software is predicting the level of crop residues of chemicals after application i.e. PARDIS [1] [Prediction of Agricultural Residue Data on fruit using an Informatic System] however its use is limited to orchards. In addition in the case of polymers, from an analytical point of view it may be difficult if not impossible to analyse the crops for residue content of this type of co formulant. The objective of this work is to develop a methodology to be applied under this conditions. As a case study we present this methodology for latex polymers i.e. polymer based on methylene succinic acid with buta-1,3-diene, styrene and methacrylic acid. [1] Prediction of agrochemical residue data on fruit using an informatics system (PARDIS model), Calliera M, Balderacchi M, Capri E, Trevisan M. 2008

MO153 Dietary exposure to pesticide residues: the big picture
L. Garcia Bouza, L. Ferreira, EFSA - European Food Safety Authority / Pesticides Unit

Science-based approaches and integrated risk assessment by using experimental data, models for pesticide residues intake estimations, monitoring data considering real exposure, etc. are working tools to contribute to the mission of the European Food Safety Authority (EFSA) on protecting European consumers’ health and the environment in the field of pesticide residues. Maximum residue levels (MRLs) are set for the upper levels of pesticide residues that are legally permissible in food of plant and animal origin. Before an MRL is established, the EFSA assesses the residue behavior of the pesticide and the dietary exposure resulting from the residues expected in food. The chronic and acute dietary consumer exposure to pesticide residues is estimated by using a calculation model developed by EFSA called PRIMO (Pesticide Residue Intake Model) based on the international agreed methodology. This provides the key information to be interpreted by risk assessors and for risk managers’ consideration. Essential input values in risk assessment are toxicological data and residue values subject to many environmental scenarios and considerations that are used to define and characterize the residues to which consumption is expected and thereby the dietary exposure. Complex metabolic pathways in plants and animals, degradation of the compounds in soils and in its transformation, the possible uptake and translocations of the residue to the edible parts of the crop and degraded products as result of industrial and household processing are considered to set the residue definitions for risk assessment purposes. Secondary metabolites characterized by metabolism studies and degraded products may pose a completely different toxicological profile than the parent compound, being more, less or equal toxic than the pesticide under assessment, and showing a new big picture for an active substance and its residues that should be assessed in detail to avoid consumers’ concerns. The dietary risk assessment of pesticide residues takes into consideration these possible scenarios in order to protect consumers, reason why residue definitions might be different for monitoring and for risk assessment purposes and where the uncertainty due to missing data might play a fundamental role in risk assessment.

MO154 Exposure and Risk Assessment for Agricultural Applicator to Insecticide Flubendiamide during Cabbage Cultivation using Whole Body Dosimetry
H. Ryu, Seoul National University / Department of Agricultural Biotechnology; D. Kim, Seoul National Univ.; E. Kim, Seoul National University / Department of Agricultural Biotechnology; J. Lee, Seoul National University / Department of Agricultural Biotechnology; Y. Shin, Seoul National University; J. Lee, College of Agriculture Sciences Seoul National Univ / Agricultural biotechnology; J. Lee, Seoul National University / Department of Agricultural Biotechnology; B. Kim, Seoul National Univ.; E. Kim, H. Ryu, Seoul National University / Department of Agricultural Biotechnology; J. Lee, Seoul National University/ Department of Agricultural Biotechnology; E. Park, S. KIM, Seoul National Univ.; M. Rehan, Seoul National University; J. Kim, Seoul National University / Department of Agricultural Biotechnology

Flubendiamide belongs to diamide insecticide that has been used to control a wide range of insects in fruit and vegetables. Assessment for agricultural applicator’s uptake by WBD was performed, which consists of cotton/polyester outer clothes and cotton inner clothes. Hand exposure was measured by washing of nitrile gloves and hands, while head exposure was monitored by face/nec face wipe technique. Inhalation exposure was evaluated with personal air sampling pumps and IOM sampler (glass fiber filter). Analytical limit of quantitation was 5.0 ng/mL with good linearity (R² > 0.99) of calibration curve. Recovery (77–117%) of insecticide from various exposure matrices were reasonable including field recovery (77–109%). Field exposure assessment was evaluated with personal air sampling pumps and IOM sampler (glass fiber filter). Analytical limit of quantitation was 5.0 ng/mL with good linearity (R² > 0.99) of calibration curve. Recovery (77–117%) of insecticide from various exposure matrices were reasonable including field recovery (77–109%). Field exposure was evaluated with personal air sampling pumps and IOM sampler (glass fiber filter). Analytical limit of quantitation was 5.0 ng/mL with good linearity (R² > 0.99) of calibration curve. Recovery (77–117%) of insecticide from various exposure matrices were reasonable including field recovery (77–109%). Field exposure assessment was evaluated with personal air sampling pumps and IOM sampler (glass fiber filter). Analytical limit of quantitation was 5.0 ng/mL with good linearity (R² > 0.99) of calibration curve. Recovery (77–117%) of insecticide from various exposure matrices were reasonable including field recovery (77–109%). Field exposure was evaluated with personal air sampling pumps and IOM sampler (glass fiber filter). Analytical limit of quantitation was 5.0 ng/mL with good linearity (R² > 0.99) of calibration curve. Recovery (77–117%) of insecticide from various exposure matrices were reasonable including field recovery (77–109%).
dermal exposure of flubendiamide was 3635.7 μg, while that of mixing/loading case was 815.3 μg. Hand exposure of flubendiamide (688.7 μg) in mixing/loading was higher than the case of application (680.8 μg). Exposure of body was highest (42.0%) in case of application. Penetration rate of insecticide between outer and inner dosimeter was about 0.5% (upper body) and 5.9% (lower body). Inhalation exposure during application was 20.2 μg while in case of mixing/loading no exposure was observed. Risk index (RI) was calculated to 0.09 using 6 μg/kg/day of acceptable operator exposure level, suggesting that health risk of agricultural applicator during treatment of flubendiamide for cabbage field would be minimum. Keywords: Flubendiamide, exposure, risk assessment, whole body dosimetry, IO, cabbage *Corresponding author: kjh2404@su.ac.kr; Tel, 82-02-880-4644

MO155 Multi-focus Surface Water Calculations: What do they mean for real regulatory cases?
D. Schaefer, Bayer Crop Science / Environmental Safety; G. Reinken, Bayer AG, Research & Development, Crop Science / Environmental Safety; A. Boleshan, Bayer AG, Research & Development, Crop Science; S. Heine, Bayer AG / Effect modelling; G. Goerlitz, Bayer CropScience AG / Environmental Safety
The water surface exposure calculations for pesticides according to FOCUS are currently under revision by an EFSA working group. In particular the working group was mandated to extend the calculation period from a preselected single year to 20 years, with the objective to better capture the effect of variable weather conditions in aquatic exposure patterns. This is meant to provide a more robust and reliable basis for aquatic risk assessments in a regulatory context. The planned revision requires decisions on some technical aspects of the calculations (e.g. evaluation of the original FOCUSsw weather data, filling of data gaps, completion of irrigation data sets, definition of multi-year application dates) and also new rules for the interpretation of the results. The main challenge in this context is the lack of an established method of calculating such long-term surface water calculations. Surface water exposure is strongly driven by individual weather events triggering run-off or drainflow, and depends in a complex way on substance properties and use patterns. Since multi-year calculations are time-consuming, a systematic investigation of the consequences of the switch to 20 year calculations and associated changes of the procedures is still missing. In this work we conducted such an investigation by running multi-year FOCUS Surface Water calculations for several substances with a range of realistic properties and use patterns, and by analyzing the resulting exposure patterns. We discuss our experiences with the calculations themselves, and present exposure characteristics of the different test substances. These allow some generic conclusions with regard to the consequences of currently discussed options for multi-year aquatic exposure calculations, and may support the technical and regulatory decisions that the EFSA working group has to take.

MO156 Effectiveness of grass buffer strips in reducing Spinosad runoff
S. Otto, Italian National Research Council, S. Gottardi, M. Pasini, Agrea SRL; R. Benelli, AgroSciences Italy srl / RD; O. de Cirugeda Helle, Dow AgroSciences
Outcome from FOCUS and a recent Document from Italian Ministry of Health allows vegetated buffer areas as a mitigation measure for runoff to surface water. The modelling framework includes default values relating to the pesticide removal efficiency of such buffers. Recent research suggests that these default removal efficiencies are not appropriate for flow conditions. Our derived values specific to Spinosad may be useful in demonstrating compliance. A GLP field study was performed in summer 2017 to test vegetated buffer strip removal efficiency, in relation to Spinosad and its major metabolites, and based to the FOCUS Surface Water risk assessment scenarios, but with worse (and prudential) conditions. The selected site was near Verona, in a hilly zone rich in vineyards and famous for high-quality wine production. Runoff containing a known amount of each of the four spinosad components to be tested (the parents – spinosyn A and spinosyn D; and the metabolites – spinosyn B and spinosyn B of D), have been artificially applied to 9 grass plots of 4.2 m width and 12 m length, with sandy-loam soil and slope ranging from 10 to 13%. Natural vegetation cover was 60-90%. The area where runoff was originated and sampled was generated in a source area of 500 m² flowering in a run-off area (buffer area) of 50 m² to evaluate its buffer capacity both in runoff displacement and concentration. Runoff event consisted in 2 phases: 1) Irrigation with sprinkler at 14 mm/h for 50 min (total: 12 mm), to simulate rainfall before runoff; 2) Run-on/Runoff event: 200 mm of water were released into the buffer area in 2:20 hours using a runoff generator (flow of 85 mm/h). Water contained a precisely defined spinosyn (1 μg/g) in its entire buffer area, the “Run-on” becomes “Runoff”, and runoff water was sampled at 0.75, 1.5 and 2.20 hours after Run-on start. During Run-on, irrigation continued until the end of run-on (other 33 mm), and a total of 45 mm were applied to buffer area. Given the frequencies of selected rainfall (low, return period of 2 years), the runoff/rainfall rate (high, 45%), the source to buffer area proportion (high, 10 to 1), and the plot slope (from 10% to 13%), conditions of the experiment can be considered highly precautionary, and more prudential that those of Focus R4. First results show that the runoff displacement ranges from 3 to 11 m from Runoff releasing. Analysis of spinosyns concentration are in progress.

MO157 EFSA’s innovative guidance on the establishment of the residue definition for dietary risk assessment
R. Leuschner, EFSA - European Food Safety Authority / Pesticides, Regulated Products (REPRO); A. Friel, EFSA - European Food Safety Authority / Pesticides Regulated Products REPRO
*The positions and opinions presented in this poster are those of the authors and are not intended to represent the views or scientific works of EFSA Commission Regulation (EU) No 283/2013 setting out the data requirements for pesticide active substances provides that the toxicological significance of compounds and their amount likely to be present shall be considered when judging which compounds are to be included in the residue definition for dietary risk assessment. The European Commission, EFSA prepared a guidance on the residue definition for dietary risk assessment which intends to complement the OECD guidance. The EFSA guidance is intended as a practical instrument helping risk assessors, on the basis of factual information (derived from toxicological and metabolism data), non-animal testing methods, by weight of evidence, to transparently: Conclude for which residues of a pesticide on food and feed commodities a hazard identification and characterisation is needed; Perform such a hazard identification and characterisation; Define the compounds that should be included in the residue definition for risk assessment. The innovative aspect of the EFSA guidance is a structured sequence of three modules, each of which addresses hazard characterisation and dietary exposure by selecting genotoxicity as the starting criteria for human health assessment. The modules are: Module 1: Exclusion of genotoxicity; Module 2: General toxicity assessment; Module 3: Decision making for residue definition for risk assessment. The guidance provides as appendices an analysis of ADI and ARID distribution for pesticide active substances and three case studies illustrating the practical application of this modular approach to derive a residue definition for dietary risk assessment for isoproturon, spiroxamine and epoxiconazole. In September 2016, EFSA organised a technical meeting on Stakeholders on its new guidance to exchange views. EFSA PPR Panel (EFSA Panel on Plant Protection Products and their Residues), 2016. Guidance on the establishment of the residue definition for dietary risk assessment. EFSA Journal 2016;14(12):4549, 129 pp. doi:10.2903/j.efsa.2016.4549. OECD (Organisation for Economic Co-operation and Development), 2009. Series on testing and assessment No. 63 and Series on pesticides No. 31 Guidance document on the definition of residue; ENV/JM/MONO(2009) 30; 28-Jul-2009. Info session on applications – pesticides - technical meeting with stakeholders on EFSA GD on residue definition for dietary risk assessment. http://www.efsa.europa.eu/en/events/event/160926

Alternative Approaches to Animal Testing for Ecotoxicity Assessments (P)

MO158 Investigations on the bioconcentration of xenobiotics in the freshwater amphipod Hyalella azteca
C. Schaefer, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; J. Hollender, Eawag / Environmental Chemistry; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; V. Kosfeld, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; D. Esser, A. Schulte, Fraunhofer IME; J. Ebersbach, Fraunhofer IME Institute for Molecular Biology and Applied Ecology; L. Bischof, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; Bioconcentration factors (BCF) are needed for regulatory purposes to assess the bioaccumulative characteristics of a substance in the aquatic environment. Traditionally these BCFS are determined in fish flow-through tests according to TGD OECD 305. These fish bioaccumulation studies are time consuming, expensive, and demand many laboratory animals. Accordingly, alternative methods that replace, reduce and refine (3Rs) this test system are needed. Two promising alternative test approaches have been developed as alternative to in-vivo BCF testing: I) An invertebrate flow-through bioconcentration test system using the freshwater amphipod Hyalella azteca and II) in vitro depletion assays with rainbow trout hepatocytes or rainbow trout hepatocyte S9 fractions. Flow-through test with almost 20 compounds showed, that the H. azteca bioconcentration test could be an appropriate test to predict bioconcentration in the standard fish test. Bioconcentration studies with H. azteca would support laboratory animal welfare considerations using a non-vertebrate species, improve efficiency and reduce costs for BCF-testing. The results of the in vitro depletion assays have been successfully applied to improve in-silico predictions for BCF values by adding the highly varied aspects of metabolic activities in the existing BCF prediction model of the European Commission, EFSA's innovative guidance on the establishment of the residue definition for dietary risk assessment.
Assessing Differences in Sensitivity to Aromatase Inhibitors Among Freshwater Fish Species


There is significant concern regarding potential impairment of fish reproduction associated with exposure to endocrine disrupting chemicals (EDCs). Aromatase is a steroidal enzyme involved in the conversion of androgens to estrogens. Inhibition of aromatase activity by exposure to chemicals can reduce levels of circulating estrogen leading to reduced synthesis of vitellogenin and production of fewer eggs by females. This mechanism has been extensively studied in the laboratory model species, fathead minnow (Pimephales promelas). However, differences in sensitivity to inhibition of aromatase among species of fish is largely unknown. This is particularly true for species that are not routinely studied in short-term reproduction assays, including many fishes of significant ecological and economic importance such as catfish (Ictaluridae), eel (Anguillidae), and perch (Percaidae). This study investigated in vitro inhibition of aromatase by the model inhibitor, fadrozole, across eighteen phylogenetically diverse species of freshwater fish. Concentrations of fadrozole that result in 50% inhibition of in vitro aromatase activity were determined from 0.0014 to 0.088 M among these species. This suggests that intrinsic differences in sensitivity to inhibition of aromatase could be greater than 60-fold among fishes. Paddlefish (Polyodontidae), white sucker (Catostomidae), rainbow trout (Salmonidae), and fathead minnow (Cyprinidae) were investigated for sensitivity to in vitro inhibition of aromatase by four additional inhibitors. Potencies of fadrozole, imazalil, prochloraz, and propiconazole relative to fadrozole were comparable among paddlefish, white sucker, rainbow trout, and fathead minnow despite up to 40-fold difference in sensitivity to fadrozole. This suggests that relative potencies generated for a model species, such as fathead minnow, could be applicable across diverse species, despite great differences in relative sensitivity. Results of this study are being used in the construction of a cross-species quantitative structure-activity relationship (QSAR) model of Biochemical Reactivity Assessment data as a relative-sensitivity adjustment for prediction of impacts at the individual and population level. This information could guide more objective ecological risk assessments of native species to EDCs that inhibit aromatase. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

Assessing differences in sea turtle organ sensitivity using cell-based toxicity assessment

K. Finlayson, Griffith University - Smart Water Research Centre / Australian Rivers Institute; F.D. Leusch, J. van de Merwe, Griffith University / Australian Rivers Institute

The long-lived nature of sea turtles and their lengthy residence in coastal foraging grounds can result in high exposure to contaminants from urban, industrial and agricultural sources. Organic or inorganic contaminants have been quantified in all species of sea turtles worldwide. However, very little is known about how these contaminants impact turtle health, valuable information for identifying populations at risk. In vitro exposure experiments using cell cultures established from turtle tissue provide an ethical, reproducible and cost-effective method to identify threats of environmentally relevant contaminants to sea turtles. In recent years, the majority of sea turtle cell lines have been established from skin samples. However, as ingestion is the main route of exposure for these animals, cell cultures established from organ tissues may be more pertinent. This study used a number of primary cell cultures established from the skin, ovary, heart, liver and small intestine from three individual green turtles to investigate the variation in sensitivity between organ types. Cytotoxicity of five organics and five inorganic compounds was investigated using a total of 13 cell lines. Differences in in vitro sensitivity was investigated based on their order of sensitivity to all compounds tested. The results were then used to assess risks to sea turtle populations worldwide. The results provide recommendations for further toxicological studies involving turtle cell lines that will allow more robust and meaningful risk assessments to be conducted for sea turtles, assisting conservation and management strategies worldwide. Our results also support the use of sea turtle cell cultures as an ethical and reliable method for investigating toxicological effects of environmental contaminants.

Comparison of rat liver S9 to an animal-free alternative ewoS9R in the Ames fluctuation assay

J. Brendt, RWTH Aachen University; B. Thalmann, EWOMIS; K. Bluhm, University of Saskatchewan; K. Kaufmann, RWTH Aachen University / Department of Biochemical Engineering; S.E. Crawford, RWTH Aachen University / Institute for Environmental, Dept. of Environmental Analysis; A. Schwi, EWOMIS; J. Büch, RWTH Aachen University / Department of Biochemical Engineering; H. Hollert, RWTH Aachen University / Institute for Environmental Research

The Ames test is the most important in vitro test for mutagenicity performed in many variants. The original agar-plate assay was modified to reduce the amount of assay components like rat liver S9 and the length of time needed for test preparation and evaluation. The Ames fluctuation test was established as a less time and manpower-intensive alternative. Differences in protein content between rat liver S9 and ewoS9R are investigated based on their order of sensitivity to all compounds tested. The results are used as a relative-sensitivity adjustment for prediction of impacts at the individual and population level. This information could guide more objective ecological risk assessments of native species to EDCs that inhibit aromatase. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

Fish scales as a tool for temporal biomonitoring of trace element concentrations

D.A. Vignati, CNRS / LIEC UMR7360; G. Masson, Université de Lorraine and CNRS / LIEC UMR7360

Direct measurement of contaminant concentrations in biological tissues is attractive for regulatory purposes because it accounts, in principle, for the environmental factors controlling their bioaccessibility and bioavailability. In the case of trace elements, the validity of this approach is confirmed by its adoption in the regulatory European framework for mercury measurement in fish. For other elements, the current framework privileges measurements in the dissolved (filterable) aqueous matrix. However, this approach provides only a limited temporal resolution of possible trends in elements’ concentrations and, where relevant, neglects uptake via dietary pathways. Furthermore, when fish is the selected matrix for monitoring, one or more individuals have to be sacrificed to collect the material necessary for analysis; a strategy that, apart from the associated ethical problems, may become problematic in situations where the number of resident fishes is limited. In this context, we propose the use of fish scales as a non-lethal, rapid and efficient alternative for monitoring trends in trace element levels in a reservoir receiving cooling waters from a nuclear power generation plant. The variations in the concentrations of Cu, Zn and lanthanides were followed in fish scales from archived fish material (Abramis brama) collected annually between 1990 and 2016. Scales were dried, calcinated and mineralized using concentrated nitric acid. After diastillation, Cu and Zn were assayed by atomic absorption spectroscopy and lanthanides by ICP-MS. For Cu and Zn, triplicate measurements generally agreed to 10% and accuracy, with respect to the standard reference material TORT2 (lobster hepatopancreas), was better than 90%. In the case of lanthanides, analysis were made on one sample per year and only La, Ce, Pr, Nd, Pm, Sm, Eu and Gd could be systematically quantified. Overall, fish scales proved to be a suitable matrix for the biomonitoring of trace element concentrations, including elements of emerging concerns such as lanthanides. Compared with fish muscle (or whole fish), fish scales are easier to preserve (no need for dissection, freezing and lyophilization) and, in some situations, may even allow repeated surveillance of the same individuals. This methodological validation study paves the way to further research to establish relationships between accumulation in scales, internal organs and biological responses.
MO164 Evaluation of QSAR models for daphnia and fish chronic toxicities of human pharmaceuticals

T. Yamada, National Institute of Health Sciences; M. Kurimoto, National Institute of Health Sciences / Division of Risk Assessment; H. Shiraishi, National Institute for Environmental Studies; H. Yamamoto, National Institute for Environmental Studies / Center for Health and Environmental Risk Research; N. Tatarazako, Ehime University / Faculty of Pharmacy, Health and Environment Research; T. Nishimura, Teikyo Heisei University / Faculty of Pharmaceutical Sciences; A. Hirose, National Institute of Health Sciences / Division of Risk Assessment

Recently, medical regulatory agencies require pharmaceutical companies to assess environmental impacts of new pharmaceutical products before marketing. Hence, it would be valuable to predict ecotoxicity of new pharmaceuticals at developmental stages where no data on fish or daphnia are available. For this purpose, two QSAR programs with ECOSAR by USEPA and KATE by Ministry of Environment in Japan are available, both of which are built using dataset of mainly industrial chemicals. In this study, we evaluated applicability and predictivity of the QSAR models using external dataset of the chronic ecotoxicity of human pharmaceuticals. The chemical structures and toxicity data based on D. magna reproduction test (OECD TG211) and fish early-life stage toxicity test (OECD TG210) were gathered from public domain. In order to examine the applicable domain where more reliable prediction results can be obtained, the following criteria were defined in this study; (1) logP values of target substances are within the lowest and highest values of the category chemicals, (2) number of category members is 5 or more, and (3) correlation coefficients of the linear regressions are greater than 0.70. Since KATE equips models for acute toxicity only in both species, Acute-Chronic Ratio of 10 was applied to estimate NOEC values. Then, ratio of calculated NOEC and measured NOEC (C/M) was determined. For ECOSAR daphnia model, 82 out of 126 pharmaceuticals satisfied the criteria. Of these, 44 pharmaceuticals had C/M between 0.1 and 10, some of which were assigned to amides or aliphatic amines. 72 pharmaceuticals had C/M between 0.001 and 0.1, 12 pharmaceuticals had C/M between 0.01 and 0.1, 100, half of which have pharmacological action to neurotransmitter receptors in human. For KATE daphnia model, 19 pharmaceuticals met the criteria. The C/M values were between 0.1 to 10 for 15 substances, most of which belong to primary amines aliphatic/ammonia, amides or imides, or neutral organics. For fish chronic toxicity, only 11 and 21 out of 72 pharmaceuticals satisfied the criteria with ECOSAR and KATE models, respectively. Further examination will be needed to expand applicability by modifying the criteria, combined with other approaches including acute-to-chronic extrapolation or daphnia-fish interspecies extrapolation.

This work was supported by the Research on Regulatory Science of Pharmaceuticals and Medical Devices from Japan Agency for Medical Research and Development, AMED.

MO165 Optimization and Accessibility of the Eco-Database and the Ecotoxicological Threshold of Concern (ecoTTC) tool

R.R. Otter, Middle Tennessee State University / Biology; M. Emby, ILSI; S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; M.G. Barron, U.S. EPA / Gulf Ecology Division; A. Beasley, The Dow Chemical Company / TERC; J. Brill, The Procter & Gamble Co. / Environmental Stewardship and Sustainability; H. Chang, FDA / Center for Tobacco Products; D. Chang, United States Environmental Protection Agency; D. Deitz, DuPont; A. DiCorato, Center for Regulatory Effectiveness; D. Farr, ILSI Health and Environmental Sciences Institute (HESI) / Health and Environmental Sciences Institute HESI; A. Kienzler, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EUR ECVAM; T.J. Norberg-King, U.S. EPA / NHEERL/Mid-Continent Ecology Division; H. Sanderson, Aarhus University / Environmental Science; P.W. Wilson, Sanofi U.S., Inc. / Health, Safety and Environmental Sciences, and explore the potential use and application of the ecoTTC concept. The Ecological Threshold for Toxicological Concern, or ecoTTC, has been proposed as a natural next step to the well-known human safety TTC concept. The ecoTTC is particularly suited for use as an early screening tool in the risk assessment process, in situations where chemical hazard data is poor, or when an appropriate QSAR is unavailable. EcotTCs are developed using statistical distributions of Predicted No-Observed Effect Concentrations (PNECs) to reflect the breadth and depth of the ecotoxicological dataset beneath, and therefore, the quality and utility of the underlying dataset is crucial to the future utility of the ecoTTC. An eco-database consisting of approximately 110,000 unique ecotoxicological records, 6200 unique CAS numbers and 1900 species from three trophic groups has been created based on recent assessments of published data and modern toxicity testing. Alternative methods to predict the effects of chronic toxicity in rodents can therefore make a significant contribution to the reduction, replacement and refinement (3Rs) of animal testing. Body weight is one of the many endpoints monitored throughout chronic toxicity tests. We aim to develop in silico models to extrapolate the effect of toxicant exposure, measured as an appropriate internal dose metric, on growth in vitro format, for a database format that is relational and scalable, facilitating easy access, sharing, and integration with other datasets and tools. This dataset is accessed via a web-based query system that is integrated with PNEC calculator and probability distribution tools. The novel interface allows users to explore the data, upload additional datasets, derive threshold values based on specific criteria, and explore the potential use and application of the ecoTTC concept. This poster will present the architecture, web-interface, and associated tools and a live demonstration of the web interface and associated web tools will be available.

MO166 Using toxicokinetic and toxicodynamic modelling to predict effects of chronic toxicity on rodent growth based on in vitro assays

T.O. Martin, Environment Department, University of York / Environment Department; R. Ashauer, University of York / Environment; P. Thorbek, Syngenta / Environmental Safety

According to 2011 figures, 80% of the animals used for testing procedures in the European Union are rodents and almost 23% are used in longer term repeated dose tests. Alternative methods to predict the effects of chronic toxicity in rodents can therefore make a significant contribution to the reduction, replacement and refinement (3Rs) of animal testing. Body weight is one of the many endpoints monitored throughout chronic toxicity tests. We aim to develop in silico models to extrapolate the effect of toxicant exposure, measured as an appropriate internal dose metric, on growth in vitro format. This allows for a database format that is relational and scalable, facilitating easy access, sharing, and integration with other datasets and tools. This dataset is accessed via a web-based query system that is integrated with PNEC calculator and probability distribution tools. The novel interface allows users to explore the data, upload additional datasets, derive threshold values based on specific criteria, and explore the potential use and application of the ecoTTC concept. This poster will present the architecture, web-interface, and associated tools and a live demonstration of the web interface and associated web tools will be available.

MO167 Screening of metabolic- and neurotoxicity of environmental chemicals using C. elegans and transgenic zebrafish models

Y. Kim, S. Lee, University of Seoul; H. Lee, University of Seoul / School of Environmental Engineering; N. Chatterjee, University of Seoul / Environmental Engineering; J. Choi, University of Seoul / School of Environmental Engineering. Metabolic and neurodevelopmental disease have been attracting attention as...
Guideline. The outcome of these in vitro assays will be presented along with the in vivo BCF data.

MO170 Chemoavailability of Organic Electrophiles - A Nonanimal Approach to Identify Candidates for Reactive Toxicity  
A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological Chemistry; G. Schüürmann, UFZ - Helmholtz Centre for environmental research - UFZ / Department of Ecological Chemistry

Organic electrophiles are important components within the exposures of humans, flora and fauna. Their toxicity toward aquatic organisms is driven by two molecular initiating events (MIE): the hydrophobicity-triggered disturbance of cellular membranes and the chemical reaction with nucleophiles, resulting in a toxicity enhancement. Most of the simple esters are considered to exert a specific toxicity through the 48-h-effect concentration yielding 50 % growth inhibition of *Tetrahymena pyriformis*. The results demonstrate that the decreasing *T*, with increasing *Km*, is caused by a rate-determining transfer-step of the electrophile from lipophilic compartments into the aqueous cytosol. Finally, chemoavailability, as a trade-off between log *Kow* and log *Km*, is shown as promising nonanimal tool to analyze whether aquatic toxicity is predominantly driven by the hydrophobic or the reactive MIE, or by both MIEs working in parallel. The authors thank the EU-funded project OSIRIS (GOCE-CT-2007-03071) and the BMBF-funded project ProHapTox (FKZ 031A422A and 031A422B) for financial support. [1] Mulliner D, Schüürmann G 2013. Mol. Inf. 32: 98-107. [2] Böhme A, Lagua A, Schüürmann G 2016. Chem. Res. Toxicol. 29: 952-962. [3] Chebechev A, Thaens D, Paschke A, Schüürmann G 2009. Chem. Res. Tox. 22: 742-750.

MO171 Local Electrophilicity Describes Experimental Glutathione Reactivity and Aquatic Toxicity toward Tetrahymena pyriformis  
D. Wondrousch, UFZ - Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

Electrophilic compounds such as *g,f*-unsaturated carbonyls are valuable reactants in organic synthesis and commonly used as industrial intermediates and products. At the same time, their electrophilic reactivity may become critical in case of uptake into organisms because of the ubiquitous presence of nucleophilic sites in proteins and DNA, resulting in reactivity driven excess toxicity. Therefore, exposure to electrophiles is of high toxicological concern. Thus, identification of toxicologically relevant compounds is desired. A step forward would be to predict – rather than measure – the electrophilic reactivity of compounds directly from their molecular structure. This would enable screening with regard to their intrinsic toxicity potential. In this work, local electrophilicity parameters were developed based on quantum chemistry. The relationship between electrophilicity and aquatic toxicity was investigated. For this purpose, their correlation with logarithmic reaction rate constants toward Glutathione (GSH) was analyzed. GSH is a small tripeptide which acts as a protector against electrophiles in the cytosol. The dataset of electrophilic chemicals contained 97 *g,f*-unsaturated esters, ketones and aldehydes. In the context of aquatic toxicity toward *Tetrahymena pyriformis*, reactive toxicity is assumed to be the primary mode of action of the aforementioned compound classes. Therefore, the descriptive power of calculated and experimental GSH reaction rate constants was compared: Both models perform equally well and yield root mean squared errors of about 0.4 log units in modeling the toxicity enhancement as deviation from narcosis level based on 48h-inhibition-growth concentrations.
narcotic compounds for algae but not for fish or daphnids. For the animal species, the regressions for esters are not the same as for narcotic compounds. The most likely explanation for this difference is the balance between hydrolysis rate and the toxic action of the parent and the degradation products. That is why they are considered as pronarcotics. A toxicity to algae in line with a narcotic mode of action suggests that the enzyme responsible for hydrolysis found in fish and daphnids is absent, therefore hydrolytic activity of esters in algae is negligible. The di-esters appear more toxic than mono-esters for fish and daphnids because they can produce two times more metabolite than mono-esters. The more reactive esters are usually unsaturated, like allyl/vinyl-esters and alpha-beta-unsaturated esters, whose double bond can be activated by the carbonyl group. For these compounds the substitution around the double bond plays a decisive role in effective reactivity. Thio-methacrylates which have an alkyl substituent in position alpha of the carbonyl are not more toxic than aliphatic esters for any of the three aquatic species. On the other hand, Acrylates clearly express excess toxicity and have to be considered as acting through yet another mechanism of action relating to a model dedicated to soft electrophiles. Rather than model the toxicity only according to structural analogy, a modelling approach is used to develop QSARs for esters based on three pillars: structure, mechanism and species metabolism.

MO173 Nano second pulsed electric field incorporation technique to predict molecular mechanisms of teratogenicity and developmental toxicity on fish embryos K. Arizono, Prefectural University of Kumamoto / Faculty of Env - Symbiotic Science; A. Yamada, National Institute of Technology, Uchida, Ariake National College of Technology / Department of Chemical and Biological Engineering; H. Ishibashi, Ehime University / Faculty of Agriculture; S. Kono, National Institute of Technology, Ariake College; N. Tominaga, Ariake National College of Technology / Department of Chemical and Biological Engineering.

We developed and applied the nano second pulsed electric field (nsPEF) treatment condition and assessed the teratogenicity and embryonic developmental toxicity by chemicals using fish embryos. Furthermore, we analyzed gene expression profiles in fish embryos using DNA microarray and performed pathway and network analyses to understand the molecular mechanisms of chemicals in teratogenicity and embryonic developmental toxicity. Our findings suggested that nPEF technique is a powerful tool for assessing teratogenicity and embryonic developmental toxicity of chemicals and predict their molecular mechanisms in fish embryos.

MO174 Moving 3D in vitro intestinal models forward: transcriptomic characterization of the RTgutGC cell line. L. M. Lanean, Plymouth University / Biological and Marine Sciences; S. Owen, AstraZeneca / Safety Health Environment; A.N. Jha, Plymouth University / Biological Sciences.

Intestinal derived cell lines are useful in vitro models which allow for focused investigation of the functional responses in the intestine. The Tufts’ M. Uchida, Ariake National College of Technology / Department of Chemical and Biological Engineering; H. Ishibashi, Ehime University / Faculty of Agriculture; S. Kono, National Institute of Technology, Ariake College; N. Tominaga, Ariake National College of Technology / Department of Chemical and Biological Engineering.

We developed and applied the nano second pulsed electric field (nsPEF) treatment condition and assessed the teratogenicity and embryonic developmental toxicity by chemicals using fish embryos. Furthermore, we analyzed gene expression profiles in fish embryos using DNA microarray and performed pathway and network analyses to understand the molecular mechanisms of chemicals in teratogenicity and embryonic developmental toxicity. Our findings suggested that nPEF technique is a powerful tool for assessing teratogenicity and embryonic developmental toxicity of chemicals and predict their molecular mechanisms in fish embryos.

MO176 Biological effects of 3 metals on "D" larvae of japonese oyster Crassostrea gigas A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiology; C. Cáceres-Martínez, Universidad Autónoma de Baja California Sur. The Japanese oyster is an introduced species from Asia, which has been cultivated in the coastal systems of the Mexican Pacific. Due to the fact that in the last 10 years the populations have had problems in their survival, in this work the evaluation of 3 biomarkers was performed in "D" larvae of this species, exposed to the metals Cd, Cr, Pb and their mixture, because these xenobiotics, are in high concentrations in the sites where the oysters are grown. Bioassays (72 hrs) were conducted where the "D" larvae were exposed to 1 µM of each metal and their mixtures in proportion 1:1. With the obtained data, the LC50 was calculated and the evaluation of 3 biomarkers was measured in the surviving organisms: the degree of lipoperoxidation (TBars: Buege & Aust. 1978), the activity of the AChE enzyme (Elliott et al., 1961) and genetic damage (Comet Test: Singh et al., 1988). The toxicity of metals according to the calculated LC50 values was: (from most to least toxic): Pb = Cd > Cr. The most toxic metal tested to the "D" larvae was Pb (45 ± 11.89 nM Tbars mg-1), followed by Cd (11 ± 6.64 nM Tbars mg-1) compared to PAHs indicating that their KE are substantially higher. Thus, for fragrance chemicals which are moderately to rapidly biotransformed, the use of 1 µM as start concentration seems to be a suitable approach to estimate the bioaccumulation potential.

MO177 Toxicity effects caused by exposure to Dichlorvos in organisms of different trophic levels A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiology; A. Perez-Rojas, Universidad Autonoma Metropolitana Iztapalapa / Laboratory of Zoology. Dichlorvos (DDVP) is an organophosphate insecticide considered by the EPA as highly toxic. Because there are few studies of the effects of DDVP in aquatic organisms The objective of this study was to evaluate the toxicity of Dichlorvos in organisms of different trophic levels Cladocerans: Daphnia magna, Daphnia exilis, Daphnia pulex and Simocephalus silicula. The ostracod Cyprip sp. and fishes: juvenile Chrysichthys chrysantherus (Jordan) and juvenile zebrasfish (Danio rerio).

In addition their sublethal effects were evaluated by means of assessment of four biomarkers (growth rate, O:N index, liperoxidation and inhibition of acetylcholinesterase enzyme). Acute bioassays were performed, the organisms were exposed to 6 pesticide concentrations to determine the LC50. Subsequently tests with duration of 15 days were made where the organisms were exposed to a sublethal concentration (LC10), for assessment of 4 biomarkers (growth rate, O:N index, liperoxidation and inhibition of acetylcholinesterase enzyme). The LC50 values obtained in the bioassays varied from 5,300 to 0.021 mg L-1. In the tests it was evident that the cladoceran Daphnia exilis was more sensitive to DDVP compared to other species.
to other species. The O:N index had values below 9 fact indicates that organisms were in a high degree of stress. Growth rates of intoxicated organisms were between 19 to 49% lower than those observed in the control group. The average concentrations of Thars registered organisms varied from 2.5 to 25.6 MThars mg-1 and show a direct dose-response relationship, since when increasing the time of exposure to DDVP increased the degree of lipid peroxidation in the tissues. A decrease in AChE activity was observed in livers between 22 and 45% and fish from 22 to 35%. The results of this study indicate that the effects of the pesticide DDVP are likely irreversible in some species.

**MO178 Characterising estrogentic activity of arctic char tissue extracts in two fish in vivo and in vitro.**

K. Petersen, NIVA - Norwegian Institute for Water Research; M. Hultman, Norwegian Institute for Water Research; J. Bytingsvik, Akvaplan-niva AS; M. Harju, NILU Norwegian Institute for Air Research; A. Evesnet, Akvaplan-niva AS; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment. Contaminants from anthropogenic activities find their way to the Arctic through long-range atmospheric transport, ocean currents and via transport by living organisms (migrating fish or seabirds). Although the levels of POPs in arctic fish are generally low, local hot-spots of contamination have been demonstrated in freshwater systems affected by seabird guano, such as Lake Ellasjøen at Bear Island (Norway). High concentrations of organic halogenated compounds have been measured in resident populations of Arctic char. Accumulation of dioxin-like compounds is up to 8 times higher levels than the lowest observed effect level for egg mortality in temperate salmonid fish raise concern that Arctic char might be at risk for adverse effects at the individual and population level. In this study the aim was to compare the toxic potency of pollutants in Arctic char from the contaminated Lake Ellasjøen with those from the less contaminated Lake Laksvatn at Bear Island. This was done by in situ sampling, extraction, and fractionation of lipids from a total of 16 individuals. The following classes of pollutants (PCB’s) were produced: F1- nonpolar POPs such as PCBs, PBDEs and most of the nonpolar pesticides, F2- polar pesticides and metabolites of POPs, and F3- polar POPs (phenolics such as chlorinated phenols and hydroxylated metabolites of PCBs and PBDEs). A method for isolation, cultivation and exposure of primary hepatocytes from Arctic char was used together with the established bioassays for primary hepatocytes from rainbow trout to investigate cytotoxic and estrogenic effects of the fractions. The estrogenic potency, measured as induction of the estrogen receptor, (ER)-mediated production of vitellogenin (Vtg), was higher in liver extracts from Lake Ellasjøen than Lake Laksvatn. Although primary hepatocytes from both species displayed estrogentic activity in response to the F1 fraction, similar induction was observed in C57BL/6 male mice hepatocytes than in hepatocytes from Arctic char. However, the Arctic char hepatocytes were more susceptible for cytotoxic effects than rainbow trout hepatocytes. F3 and F2 from both fish populations (Lake Ellasjøen and Lake Laksvatn) appeared to have similar effect on cell viability with F3 having largest effect. Chemical analysis was performed to identify potential contributors to the observed effects in rainbow trout. The project was funded by the Norwegian Research Council, project. No. 221373.

**MO179 Ultrasound: A novel approach to non-lethally measure hepatosomatic index in sentinel fish for environmental monitoring programs.**

A. Fure, University of Saskatchewan / Veterinary Biomedical Sciences; Y. Palagi, ISD-Experimental Lakes Area; P. Borrett, University of Saskatchewan; L. Hrenchuk, ISDExperimental Lakes Area; M. Murdoch, Stantec Consulting Inc; L.P. Weber, University of Saskatchewan / Veterinary Biomedical Sciences Canada’s environmental effects monitoring (EEM) program studies impacts of metal mining and pulp mill effluents on aquatic receiving environments. The EEM regulations recommend lethal sampling of 20 fish (male and female) of different species to study body condition, liver size (hepatosomatic index-HSI), and gonad size (gonadosomatic index-GSI) during every monitoring cycle. Developing and implementing non-lethal methods for environmental monitoring programs provides an opportunity to protect sentinel endangered fish which might be threatened by protected species legislation. Ultrasound was observed in rainbow trout that are part of systems with low productivity. Ultrasound is a non-invasive tool that has been tested to assess gonad size in fish. Currently, its potential as a non-lethal tool in environmental monitoring programs is not well explored. We conducted feed withdrawal studies in the laboratory to test the accuracy and sensitivity of ultrasound to measure HSI in sentinel fish with a compact liver such as rainbow trout (Oncorhyncus mykiss). With the ultimate goal of providing empirical evidence of the applicability and ease of this technique in the field, we also tested the accuracy of ultrasound method to measure HSI in lake trout (Salvelinus namaycush) at ISD-experimental lakes area. Our laboratory studies provide a significant correlation for the accuracy (HSI, r²=0.73, n=16, p< 0.05) and evidence for the sensitivity of ultrasound method (p=0.06, n=7) versus traditional lethal gravimetric method (p=0.05, n=7) to measure HSI within the acceptable critical effect size for HSI mandated by EEM. Our field ultrasound method testing also revealed a significant correlation between the traditional lethal and ultrasound method in measuring HSI (r²=0.81, n=9, p< 0.05) in lake trout. Our field analyses provide evidence for the ease and potential application of this technique for future environmental monitoring programs. Our ongoing method refinement and exploration of this technique in sentinel fish with diffuse livers across different size ranges will strengthen our goal of proposing ultrasound as a viable non-lethal alternative to measure HSI on a global scale.

**MO180 Weight of evidence for fish acute toxicity: a Bayesian network modelling approach**

J. Møg, Norwegian Institute for Water Research (NIVA) / Section for Catchment Processes; A. Lillicrap, NIVA / Ecotoxicology and Risk Assessment; W.G. Landis, Western Washington University / Institute of Environmental Toxicology; S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization.

Reduction of animal testing wherever possible is requested by EU Directive 2010/63/EU. Fish Embryo Toxicity (FET) testing can be an alternative to using juvenile fish in acute toxicity testing. However, FET data are currently not accepted as a replacement to juvenile fish acute toxicity data for regulatory purposes such as REACH, without sufficient weight of evidence (WoE). The development of a novel WoE approach for FET data has been recommended by the European Chemicals Agency to significantly reduce the number of animals required for hazard assessments of chemicals. We propose a Bayesian network (BN) modelling approach for quantifying the weight of evidence. BN is a probabilistic modelling methodology which is an increasingly used in ecological risk assessment as well as in quantitative biological and ecotoxicological research.

The proposed BN model is to integrate information from large and varied ecotoxicological and physico-chemical datasets, and apply it in a WoE approach to predict fish acute toxicity of chemicals from data on fish embryo toxicity testing in combination with other relevant information. The planned steps of the model development and application are: (1) Identification of suitable chemical properties and endpoints as nodes for the BN. (2) Compilation of data on ecotoxicity data for fish embryos and other relevant information. (3) Construction of a BN model for integrating the data and other information in a probabilistic framework. (4) Evaluation of the WoE approach using ecotoxicity data for fish embryos in combination with data on (juvenile) fish acute toxicity. (5) Application of the BN model to assess the risk of various contaminants based on chemicals registered in the European Chemicals Agency database (http://echa.europe.eu).

**MO181 Divergent immunomodulatory effects of cadmium between two marine immune cell models in vitro, macrophages and mast cells.**

L. Da-Cruz, Wageningen University, N.L.H. van der Berg, N. van den Brink, Wageningen University / Dept of Toxicology.

Cadmium can induce toxic effects via different mechanisms, e.g. depletion of cellular antioxidants leading to increase of ROS levels and induction of apoptosis. Such effects have been addressed in different types of tissues and cells, including the immune system. However, these mechanisms of toxicity may have different impacts among physiological and pathological studies. The purity of the target cells to deal with these toxic effects. Considering the multitude of different types of immune cells and cell-subsets with different functions, cadmium could impair immune functions, such as the immune responses against infections, through cell-type specific effects. Macrophages and mast cells are two types of innate immune cells part of the first line of defence, able to initiate fast inflammatory responses. Each cell type has different mechanisms in the two main types of inflammatory responses, type 1 and type 2. Type 1 or cell-mediated inflammation is involved in the defence against intracellular bacteria and infected cells, carried out especially by phagocytes like macrophages. In contrast, mast cells are associated with type 2 or humoral/antibodies-mediated immunity, concerned with extracellular pathogens and parasitic infestations. In order to study the immunomodulatory effects of cadmium on macrophages and mast cells we carried out a mechanistic in vitro study. Exposure to cadmium depletes glutathione in the four cell lines tested, potentially modulating functional parameters in macrophages mainly as a result of activation of redox-sensitive pathways leading to pro-inflammatory effects. Mast cell showed steeper GSH-depletion, compared to macrophages, prior to the onset of cytotoxicity, indicating increased ROS levels, resulting in potentially increased oxidative stress. A dose-response inhibition in the secretion of histamine was shown, suggesting that mast cell function could be impaired by cadmium. In this way, cadmium may modulate the function of the innate immune system, in such a way, that favours to a type 1 response by enhancing macrophages responses and at the same time affecting the functioning of mast cells.

**MO182 Changes in protein expression of primary sea turtle cells exposed to contaminants indicate the potential for in vitro proteomics as a high throughput tool to support biomarker discovery.**

S.J. Chaousis, Griffith University / Smart Water Research Centre / Australian Rivers Institute; F.D. Leusch, Griffith University / Australian Rivers Institute; A. Nouwens, The University of Queensland / School of Chemistry and Molecular Biology; J. van de Merwe, Griffith University / Australian Rivers Institute.
The development of biomarkers of chemical exposure and effect in threatened wildlife is challenging because traditional methods for biomarker discovery that involve in vivo testing or destructive sampling cannot be utilised. These challenges have long since been acknowledged and the development of non-destructive methods for the detection of biomarkers in wildlife has been examined for many decades. However, despite these efforts, progress in this field has been slow and the development of non-destructive biomarkers of exposure and effect, optimised extraction and analysis methods and aims to identify the position of environmental chemicals in threatened wildlife has been limited. The usefulness of cell lines along with non-targeted omics has not been well explored in this context despite the potential for these methods to greatly enhance non-destructive biomarker development. In order to assess the potential of these methods for the development of biomarkers of exposure and effect, we optimised extraction and analysis methods and aimed to identify the position of environmental chemicals in threatened wildlife.

MO183 Baseline vs. Reactive Toxicity toward the Nematede C. elegans as Alternative Bioassay

M. Amposah-Ofeh, University of Duisburg-Essen; S. Saleem, E. Böttner, A. Bier, A. Paschke, UFZ. Helmholtz Centre for Environmental Research / Department of Ecological Chemistry; G. Schürmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

The nematede Caenorhabditis elegans is the first multicellular organism with a completely sequenced genome. Since more than 20 years, it has been employed as a model organism for assessing the environmental toxicity associated with sediments. The nematede C. elegans is attractive as alternative bioassay for the ecotoxicity criteria. The scheme will be applied to other categories of chemicals, such as the biocides within the LIFE COMBASE project. We used the three new continuous QSAR models for acute and chronic endpoints for the main trophic levels: EC50, NOEC and NOEC algae (Daphnia magna), EC50, NOEC and NOEC fish (Oryzias latipes) and NOEC fish (more fish species). We used geasel and VSURF to select the DRAGON descriptors and the tree ensemble (random forest) method to derive the models, obtaining good performance (R2 > 0.96 on the training set and up to 0.78 on the validation set when the applicability domain is considered). We used the three new QSARs on chronic endpoints to perform the assessment of chemicals; we used the three new QSARs and the seven ones implemented in the VEGA platform (https://www.vegahub.eu/) on acute endpoints for screening purposes (two QSARs for Daphnia magna, two generic QSARS for fish, three QSARS for specific fish species). The ecotoxicity workflow is divided in three parts: algae, Daphnia magna and fish. For each part and each endpoint, the workflow integrates the experimental values (if any), the QSAR predictions and their reliabilities. The experimental values have a higher reliability than the predictions. The reliability takes into account the intra- and interspecific variability, the most sensitive species and the applicability domain index of the predictions. The users can choose a consensus or a worst-case approach. The experimental values and the predictions are included to the regulatory thresholds to verify if the ecotoxicity criterion is fulfilled for each trophic level. The final assessment for ecotoxicity is based on the integration of the assessment of the trophic levels (the values and their reliabilities) and the number of trophic levels that fulfil the ecotoxicity criteria. The scheme will be applied to other categories of chemicals, such as the biocides within the LIFE COMBASE project. The authors thank the projects JANUS (contract Z 6 - 80170/20 - 3716 65 414 0) by Umweltbundesamt (UBA) and LIFE COMBASE (LIFE15 ENV/ES/416) for financial support.

MO184 Oxidative Activation of Pro-Electrophiles Mediated by an Fe-loaded Zeolite - A Non-animal Tool for Mimicking Phase I Metabolism

J. Moldricks, Helmholtz centre for environmental research - UFZ / Ecological chemistry; A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological Chemistry; A. Becker, Leipzig University; G. Schürmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

The electrophilicity of a chemical substance can have a significant impact on its toxicological profile, as this property determines the chemical's ability to form adducts with electron rich sites of proteins, lipid components, DNA and RNA. In many cases, this type of adduction formation is the molecular initiating event (MIE) of a complex adverse outcome pathway. Kinetic chemosays, which address this type of MIE, are used for the quantification of a test chemicals' reactivity towards typical biological targets, and have facilitated the development of e.g. models for the prediction of the aquatic excess toxicity or skin sensitization potential. Apart from chemicals that possess electrophilic substrucbures in their initial form, there are compounds that can become electrophilic only after abiotic or biotic oxidation. The reactive toxicity of these chemicals, also described as pro-electrophiles, is often difficult to characterize with simplified model systems like chemoassays or in vitro bioassays because these methods typically do not sufficiently include an activation step. Our presentation introduces a new tool, based on an Fe-loaded zeolite, that is able to mediate the transformation of pro-electrophoric phenol and dithiocarbamates, derived from their parent compounds, to reactive electrophiles that are trapped by coinubation with the tripeptide WCY (tryptophan, cysteine, glycine) and analyzed using high performance liquid chromatography coupled to tandem mass spectrometry. Profiling of the obtained adduct patterns enable the identification of formed electrophiles, and provides new insights into the contribution pathways causing the reactive toxicity of pro-electrophiles. The authors thank the EU-funded project OSIRIS (GOC-C-2007-037017) and the BMBF-funded project ProFlapTox (FKZ 031A22A and 031A22B) for financial support.

MO185 Integrated assessment of aquatic ecotoxicity for regulatory purposes

c. cappelli, IRCCS - Istituto di Ricerche Farmacologiche Mario Negri; C. Toma, IRCCS - Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; A. Manganaro, Kode s.r.l.; D. Gadaleta, IRCCS - Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; J. Arning, German Environment Agency UBA; A. Biegel-Engler, German Environment Agency - UBA / Chemicals; E. Benfanti, IRCCS - Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; B. Kelley, ExxonMobil Biomedical Sciences

The REACH regulation requires the assessment of the CMR and PBT properties of the chemicals produced or imported in EU in amounts exceeding 10 t/a in order to protect the human health and the environment. The JANUS project aims at the development of a JAVA application to prioritize and assess the chemicals according to the PBT, CMR and endocrine disruption properties with uncertainties estimation. To assess the ecotoxic part of the toxicity, we developed six continuous QSAR models for acute and chronic endpoints for the main trophic levels: EC50 96h and NOEC 96h algae (Raphidocelis subcapitata), EC50 48h and NOEC 21d Daphnia magna, LC50 96h fish (Oryzias latipes) and NOEC fish (more fish species). We used geasel and VSURF to select the DRAGON descriptors and the tree ensemble (random forest) method to derive the models, obtaining good performance (R2 > 0.96 on the training set and up to 0.78 on the validation set when the applicability domain is considered). We used the three new QSARs on chronic endpoints to perform the assessment of chemicals; we used the three new QSARs and the seven ones implemented in the VEGA platform (https://www.vegahub.eu/) on acute endpoints for screening purposes (two QSARs for Daphnia magna, two generic QSARS for fish, three QSARS for specific fish species). The ecotoxicity workflow is divided in three parts: algae, Daphnia magna and fish. For each part and each endpoint, the workflow integrates the experimental values (if any), the QSAR predictions and their reliabilities. The experimental values have a higher reliability than the predictions. The reliability takes into account the intra- and interspecific variability, the most sensitive species and the applicability domain index of the predictions. The users can choose a consensus or a worst-case approach. The experimental values and the predictions are included to the regulatory thresholds to verify if the ecotoxicity criterion is fulfilled for each trophic level. The final assessment for ecotoxicity is based on the integration of the assessment of the trophic levels (the values and their reliabilities) and the number of trophic levels that fulfil the ecotoxicity criteria. The scheme will be applied to other categories of chemicals, such as the biocides within the LIFE COMBASE project. The authors thank the projects JANUS (contract Z 6 - 80170/20 - 3716 65 414 0) by Umweltbundesamt (UBA) and LIFE COMBASE (LIFE15 ENV/ES/416) for the financial support.

MO186 An integrated testing strategy to fill data gaps for environmental risk assessment of isoo-alcohols

G.E. Bragin, ExxonMobil Biomedical Sciences, Inc., Toxicology and Environmental Sciences; B. Hedgethoven, ExxonMobil Biomedical Sciences, Inc.; C.A. Sutherland, ExxonMobil Biomedical Sciences, Inc., Toxicology and Environmental Science; B. Kelley, ExxonMobil Biomedical Sciences Inc.; K. Butler, ExxonMobil Biomedical Sciences Inc.; A. C. Collier, ExxonMobil Biomedical Sciences Inc., Toxicology and Chemistry Laboratory; M. Lampi, ExxonMobil Biomedical Sciences Inc., Environmental risk assessments require quality data to provide defensible environmental quality benchmarks. Quantitative Structure Activity Relationship (QSAR) endpoint estimates are often appropriate for alcohols with a very strong correlation to aquatic toxicity test data. However, QSAR estimates require comprehensive justification to demonstrate applicability, and still may not fully meet regulatory requirements, leading to extensive long-term toxicity testing. Here, limited, strategic environmental testing was used to support QSAR predictions, thereby reducing animal testing while still meeting regulatory requirements.
Aquatic toxicity testing with algae, daphnids and fathead minnows (OECD 201, ISO 20665 and OECD 210) was performed with isoocetan and isoundecanol. The study objective was to employ a testing program consisting of long-term fish (limit test), invertebrate and algal toxicity tests to demonstrate that QSR estimations accurately predict aquatic effects from long-term continuous exposure to these substances, further supporting the use of QSR models across a range of ionogenic surfactants. The data demonstrate that the QSR model employed accurately characterized the hazard of iso-alcohols and is protective of these endpoints. Moreover, this combined information, by demonstrating a regular and predictable pattern of toxicity amongst these substances, further justifies read-across between substances for other endpoints (such as bioaccumulation) and supports efficient use of data for general purpose risk assessments.

MO187
Looking for an alternative to glyphosate-based herbicides
V. Lioussia, K. Eisner, S. Limbeck, D. Rünzler, University of Applied Sciences Technikum Wien / Department of Biochemical Engineering
Glyphosate-based herbicides are widely used in agriculture. When these products were originally introduced to the market they were intended to affect only target species i.e. plants. However, over the past decades there is growing evidence on the toxicity and genotoxicity of glyphosate on non-target species. On 27th November 2017 the EU member states agreed on a five-year renewal period for the use of glyphosate based herbicides. However, in case glyphosate-based herbicides become prohibited eventually, the availability of alternative active substances will become an urgent need. Nonanionic (a.k.a. pelargonic acid) is a biological derived substance considered as an environmentally friendly herbicide. Its toxicity to mammals is low and is also not expected to have adverse effects on non-target organisms. The aim of the present study was to compare the toxicity levels of glyphosate and a glyphosate based herbicide pelargonic acid and a pelargonic acid-based herbicide on aquatic ecosystems using zebrafish as a model organism. In order to do so, we investigated the effect of both active substances and their formulations on the developmental stages of zebrafish embryos (OECD Guideline, Test No 236). The corresponding values of LC50 were calculated. The larvae that hatched from the acute toxicity tests were recorded in the observation chamber DanioVision and their swimming behavior was evaluated in EthoVision software. The potential effect of the tested substances on the respiratory system of aquatic organisms was investigated in vitro by performing the Neutral Red Uptake assay on the trout-derived gill cell line RT Gill-W1. Results of our in vivo and in vitro tests indicate that pelargonic acid and its formulation are more toxic (acute toxicity) than glyphosate and its based-herbicide. Furthermore, the behavioral assay indicates a potential for a neurotoxic effect of pelargonic acid on zebrafish larvae. To our knowledge so far there are no available data for a neurotoxic effect of pelargonic acid on aquatic organism. Hence, this outcome has to be further investigated.

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MO188
Chemoseq Profiling of Salicylates to Assess Their Reactive Toxicity
A. Werner, Leipzig University; A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological chemistry; G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry
Salicylates are widely used as fragrance additives or UV light absorbers in cosmetics and consumer care products, and thus can contribute to the human exposome. Moreover, they can be released into the aquatic environment where they may act as constituents of the组成esomes of waterborne flora and fauna. As organic electrophiles, salicylates are able to bind to nucleophilic sites of proteins, peptides or the DNA, thus triggering the reactive molecular initiating events of aquatic excess toxicity or dermal sensitization. For assessing the toxicological hazard of organic electrophiles, chemoseq has turned out to be promising as it is noninvasive and allows to detect changes at mRNA, protein and DNA levels. For this chemoseq analysis to be feasible, we have developed a new assay approach to detect reactive sites in fish gill cells. Results show that our method works well and is promising to be used in the future for In Vitro toxicity testing. This will help to detect potential new hazards at an early stage and prevent them from entering the environment.

MO190
The Xenopus Embryonic Thyroid Signalling Assay (XETA) for assessment of effluents contamination in thyroid active molecules.
D. Du Pasquier, Watchfrog S.A.; S. Guerin, V. Rocher, SIAAP; J. Mougel, AQUIRIS; A. Tindall, G.F. Lemkine, Watchfrog S.A.
The Xenopus Embryonic Thyroid Signalling Assay (XETA) was designed as a simple, rapid (< 72h) way to provide information on the potential of a test substance or a sample to alter the normal functions of the thyroid system. The XETA provides a rapid (≤72h) test to measure the response of embryonic stage tadpoles to potential thyroid disrupting chemicals, allowing a efficient method for screening thyroid disruptors. XETA could provide an alternative to complex in vivo tests. It can be used for screening large number of molecules or testing environmental samples that couldn’t be stored or sampled in large quantitative. OECD is currently validating this in vivo assay, the final stage of validation has been completed in 2017 and it is expected that the XETA may be approved as an OECD Test Guideline by 2019. OCDE validation focus on using the XETA to test pure chemicals but this test could be particularly useful for the hazard assessment of effluents. During the 12 past years we applied this assay to effluents including municipal wastewater, treated wastewater, industrial wastewater and oil residues. A part of our studies focused on performances of wastewater treatment plant (WWTP). Assessing the quality of the WWTPs outlets for endocrine active molecules is a major challenge for reaching the good ecological status of the natural water bodies defines by the EU Water Framework directive. An evolution of the water treatment process is required to remove the endocrine effect presents in the wastewater. The evolution should include measurement of the thyroidic hormone to allow the control of the treatment process. Only Bioassays have the capacity to integrate the effect of all compounds present into a global hormonal potential and are therefore promising tools for future development of in-line assessment. Our results using the XETA on WWTP effluents showed: 1) Daily variations of the thyroidic effect in wastewater are linked to electricity consumption and rainfall. In WWTP still contains thyroid active molecules, results from chemical analysis performed on the same samples indicated a correlation between the total micropollutant load, and the thyroidic effect. 3) A minor part of the thyroid effect removal occurs during and after the process. The major removal of the thyroid active molecule occurs during the nitrification step of the water treatment.

MO191
Advances in locomotion detection of Daphnia magna, Artemia franciscana and Parameca caudatum
F.M. Salzer, V. Lioussia, X. Monforte Vila, D. Rünzler, University of Applied Sciences Technikum Wien / Department of Biochemical Engineering
Animal behavior is complex and multidimensional. Over the past decades, researchers tried to qualify and quantify it, in order to understand and predict it. The advances in this field are so radical that they actually formed a new scientific domain called “computational ethology”. A major gap in this field is that most of research is focused on vertebrates, were only few studies dealt with invertebrates. In general, invertebrate locomotion is studied under specific conditions and at a specific stage of the organism’s life cycle. In this work, we evaluate the potential of using the XETA on WWTP effluents showed 1) Daily variations of the thyroidic effect in wastewater are linked to electricity consumption and rainfall. In WWTP still contains thyroid active molecules, results from chemical analysis performed on the same samples indicated a correlation between the total micropollutant load, and the thyroidic effect. 3) A minor part of the thyroid effect removal occurs during and after the process. The major removal of the thyroid active molecule occurs during the nitrification step of the water treatment.
studies focus on terrestrial and aerial species in comparison to aquatic organisms. A reason for this discrepancy is that compared to terrestrial species, additional physiological and behavioral responses are involved.

Toxicology in sentinel species is urgently needed, as locomotion and/or swimming behavior can be used as an endpoint for studying neurotoxic effects. As a result, the aim of the present study was to improve the current tracking techniques of Daphnia magna, Artemia salina, and C. riparius. In the last year, we evaluated the prediction performance of Daphnia magna reproduction and of the fish chronic toxicity. In this study, we evaluated prediction performance of the acute and chronic toxicity for algae. We used the ecotoxicity test data sets of about 100 pharmaceuticals. The EC50 values for the acute toxicity and the ChV for the chronic toxicity were compared with the prediction values estimated by the ECOSAR. The percentages of the pharmaceuticals of which the predictive values are different in less than one digit from the actual measured values are 43% and 44% for acute and for chronic toxicity, respectively. Overall applicability of toxicity prediction for algae was similar to that of toxicity for Daphnia magna or fish. In the case of Daphnia magna or fish, some antibiotics, anti-cancer, central nervous system agents with lower LogPow were underestimated. However, there is little dependency of LogPow in the case of algae toxicity. Most of chemicals with aliphatic amines had tendency to be underestimated. This difference may reflect on the mode of actions between Daphnia/fish and Algae in order to improve the predictability of the in silico ecotoxicity QASAR tool, more researches on discovering the structure dependent toxicological profile of Algae would be needed. This work was supported by the Research on Regulatory Science of Pharmaceuticals and Medical Devices from Japan Agency for Medical Research and Development, AMED.

MO193
SeqAPASS to Evaluate Conservation of High-Throughput Screening Targets Across Aqueous Environments
Cell-based high-throughput screening (HTS) and computational technologies are being applied as tools for toxicity testing in the 21st century. The U.S. Environmental Protection Agency (EPA) embraced these technologies and created the ToxCast Program in 2007, which has served as a screening and prioritization tool for thousands of chemicals. The rapid and automated screening methods take advantage of hundreds of (primarily) mammalian-based HTS assays for identifying biological activity suggestive of potential toxic effects. The data can aid in identifying chemicals that are most likely to impact biological pathways that lead to adverse health effects. To realize the full potential of the ToxCast data for predicting adverse effects to both humans and wildlife, it is necessary to understand how broadly these data may plausibly be extrapolated across species. Therefore, the U.S. EPA Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool was used to evaluate conservation of the 460 protein targets represented in the ToxCast assay suite. The SeqAPASS query sequence was selected based on the model organism used in the ToxCast assay (e.g., human, cattle, chimpanzee, guinea pig, rabbit, rat, mouse, pig, or sheep). Similarity of primary amino acid sequences and sequences from appropriate functional domains were compared across species to identify target across taxa. To demonstrate application of the SeqAPASS data for extrapolation of ToxCast targets, case studies were developed that focused on the extrapolation of targets being evaluated as part of the Endocrine Disrupter Screening Program, including the androgen receptor, enzymes involved in steroidogenesis, and proteins in immune function. These case studies demonstrated the utility of SeqAPASS for informing the extrapolation of HTS data and identification of model organisms likely to be suitable for follow-up or complementary in vivo toxicity tests. The contents of this abstract neither constitute nor reflect official US EPA policy.

MO194
In silico site-directed mutagenesis informs species-specific predictions of chemical susceptibility derived from the Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool
The Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool was developed to address needs for rapid, cost effective methods of species extrapolation of chemical susceptibility. Specifically, the SeqAPASS tool compares the primary sequence (Level 1), functional domain sequence (Level 2), or individual amino acid residue sequence (Level 3) of the protein target of a chemical in a known sensitive species to sequences of other species and calculates sequence similarity metrics to predict potential cross-species chemical susceptibility. Level 3 analyses offer the greatest resolution for extrapolation of chemical susceptibility across specific species, but uncertainties into the role of specific amino acid substitutions at key positions of proteins and whether they affect interaction with chemicals made manual interpretation of Level 3 analyses time consuming and potentially inconsistent. Therefore, this study used in silico site-directed mutagenesis coupled with docking simulations of computational models for acetylcholinesterase (AChE) and ecdysone receptor (EcR) to investigate how specific amino acid substitutions impact protein-chemical interaction. This study found that substitutions in identities of key amino acids cause no change in chemical interaction with a protein if residues share the same side chain functional properties and have comparable molecular dimensions, whereas differences in side chain functional properties or molecular dimensions can reduce protein-chemical interaction. These findings were considered in the development of automated Level 3 analyses and enabled automatically generated species-specific predictions of chemical susceptibility. These predictions were shown to agree with Level 1 and 2 predictions of AChE and EcR for more than 90% of investigated species, but also identified dramatic species-specific differences in chemical susceptibility that align with results from standard toxicity testing. The consistency of automated predictions of susceptibility across Levels 1, 2 and 3 and agreement with results of standard toxicity tests provides a compelling line-of-evidence for use of SeqAPASS in generating species-specific chemical susceptibility predictions across broad taxonomic groups applicable to addressing challenges in species extrapolation for human and ecological hazard assessment. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

MO195
Survival and Teratogenic Evaluation of 91 compounds with environmental impact
S. Calzolari, ZeClinics
ZeClinics (www.zeclinics.com) is a biotech company interested in developing efficient and reliable zebrafish screening tests to predict compound toxicity in mammals and organ related endpoints. As part of the development of a universal set of rules – incubation time, chorion/no chorion, analysis timing, type of end endpoints, analysis procedure, etc. – that can be applied by all the zebrafish toxicology community (SOP like protocols) and, eventually, to become the base for applying towards regulatory approval for the standardized test. In this study, we have performed a Developmental Toxicity Test on the NTP 91 compound list. For each compound, 20 zebrafish embryos (at 48 hpf) were exposed to 5 different concentrations (Log3 dose/response curve: 100µM, 33 µM, 10µM, 3.3 µM and 1µM) for a single biological replicate. Experiments were performed in chorionated embryos from 3 hpf to 96 hpf. Endpoints were analysed at 24, 48 and 96 hpf. Quantified phenotypes include mortality rate and teratogenic endpoints such as body deformity, scoliosis, pigmentation, heart edema and motor behaviour. It is important to note that the majority of the provided compounds were already dissolved in DMSO at 10 mM. This fact limited the range of maximum concentrations tested, which might have impacted in a lower-than-expected correlation between zebrafish and human data. In fact, 49/91 compounds did not
show any toxic phenotype at the maximum evaluated concentration. On the other hand, 39 displayed mortality and teratogenic phenotypes. Among them, the most toxic compounds were Saytex CP-2000, 4,4-hexafluoroisopropylidene diphenol, 3-lodo-2-propynyl n-butylcarbamate, diethyldithiobestrol, hexachlorophene, methylmercury chloride, rotenone and tetraethylthiuram disulfide.

**MO196**

**MPA - an alternative for the standard procedure of Ames Test**

J. Rossetto Martins Zwarg, School of Technology, UNICAMP; D.A. Morales, State University of Campinas / Faculty of Technology; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; G. Umbuzeiro, School of Technology, UNICAMP / LAEG

The Salmonella/microsome assay (Ames Test) is the most widely used mutagenicity test for evaluation of pure chemicals and environmental samples. There are several protocols available in the literature, including those that reduce the amount of sample needed for testing with liquid and agar media. There is a miniaturized version using liquid media called Microplate Fluctuation Protocol (MFP) that has been extensively used specially in Europe. It is has similar sensitivity with the standard Ames as well as other protocols and good performance in interlaboratory studies. However, the MFP has some disadvantages such as being difficult to apply with strains with low and high spontaneous mutation frequencies. Another miniaturized version of the Ames test is the microsuspension assay, which is 13 to 20 times more sensitive than the standard protocol. It is performed 5X concentrated bacteria and less sample and S9 mixture but still uses conventional petri dishes (90 x 15 mm). It has been extensively used for environmental samples testing, including in Effect Directed Analysis (EDA). The objective of this study was to miniaturize of the microsuspension Salmonella/microsome assay using agar microplates under the concept of the 3R principle. The conventional plates were replaced by plates with 12 micro wells. For validation of this miniaturization, we selected 13 known more or less potent mutagenic compounds. Six were tested only with metabolic activation (S9) and the other 7 were tested only with S9 using three Salmonella tester strains that were selected based on their different spontaneous reversion frequencies (low, mean and high). The miniaturization procedure conditions were made as similar as possible to the Microsuspension protocol, using the same testing design, metabolic activation, and data interpretation. Each test was conducted in parallel. MPA and Microsuspension protocols showed 100% agreement, qualitatively and quantitatively. MPA is less laborious, uses less sample, materials, and reagents reducing overall costs. The amount of sample required for testing is at less 20 times less in comparison with the standard Ames assay. We conclude that MPA is a promising tool and could be used in substitution of the standard Ames procedure especially in situations where sample quantity is a limitation such as impurities, drugs in development and environmental monitoring studies.

**MO197**

**SETAC Animal Alternatives Interest Group**

A. Lillicrap, NIVA Norwegian Institute for Water Research / Ecotoxicology

**Bioavailability and realistic risk assessment of organic chemicals (P)**

The fate of organic chemicals and their metabolites in soils is often investigated in model matrices having undergone various pretreatment steps that may qualitatively or quantitatively disturb results. Presently, effects associated to γ-irradiation, spiking and dwelling of earthworms were studied in field-contaminated soils (sterilization after contamination) and freshly spiked (sterilization prior to contamination) soils for the case of 1,1-dichloro-2,2-bis(p-chlorophenyl) etylene (p,p’-DDE). Changes in its sorption and bioavailability were linked to the changes in soil organic matter (SOM) chemistry measured by Diffuse Reflectance Infrared Fourier Transform (DRIFT) spectroscopy. Qualitative interpretation of obtained DRIFT spectra revealed changes in SOM chemistry manifested in a reduction of aliphatic moieties (earthworms dwelling). Using DRIFT, changes induced by spiking and earthworms were noted to be more pronounced compared to sterilization. The variation of bioaccumulation factors (BAFs) of native and spiked p,p’-DDE in sterile and nonsterile soils was limited to a factor of 1.5., depending on the incubation time and the particular approach used for BAF calculation. Despite the absence of quantitative effects of γ-irradiation on p,p’-DDE bioaccumulation, the uptake kinetics were shown to vary between

**MO199**

**In situ passive sampling methods to measure freely dissolved concentration of PAHs in contaminated soil: comparison with ex situ measurements and evaluation over one year**

N. Bartosz, Agroscope Reckenholz-Tänikon Research Station ART / Helmholtz Centre for Environmental Research (RECETOX); K. Brandstätter, University of Campinas / Faculty of Technology; W. Brack, Helmholtz Centre for Environmental Research UFZ / Environmental Analytics; I. Hilber, Agroscope / Environmental Analytics; R. Sculini, ETH Zurich / Department of Environmental System Science; P. Mayer, Technical University of Denmark / Department of Environmental Engineering; T. Bacheli, Agroscope ART / Environmental Analytics

Bioavailability studies can be used to improve risk assessment and legislation relating to soil and sediments. Passive sampling (PS) methods are becoming very useful for risk assessment purposes in the field of hydrophobic organic contaminants (HOC). Over the past decade, researchers have successfully developed various passive sampling (PS) methods to assess the freely dissolved concentrations of HOC in soil pore water or suspensions (C_diss). The C_diss play a key role for environmental fate and toxic effects of these compounds. Field conditions such as temperature, ionic strength or soil water content may influence the distribution of HOCs. Therefore, are accounted for when setting up in situ PS methods for providing promising results to measure C_diss in the pore water of sediments, there is still very little information on the suitability of these methods for their application to soils, particularly under unsaturated water conditions. Here, we present the results of in situ PS concentrations of polycyclic aromatic hydrocarbons (PAHs) in six different PAH contaminated field soils. The PAHs were located in peat bogs and hence permanently water-saturated, while the other three were located in grassland and thus not saturated. Low density polyethylene (LDPE) was used as PS method. The samplers were deployed in situ covering a depth of 20 cm below the soil surface. Concentrations were assessed at all sites after six, nine and twelve months of exposure. For comparison, soil samples from the same locations were analysed using a conventional ex situ soil suspension method. The main objectives of this study were (1) to compare the measurements obtained with the two sampling methods, (2) to assess the influence of soil water saturation of the measurements (unsaturated versus saturated), and (3) to determine the role of seasonal variation (temperature and precipitation variation) and exposure time on the results of the in situ PS method. To our knowledge, this is the first experiment where PS methods were used to determine PAH concentrations in the pore water of soils under field conditions in situ and to study the impact of soil water saturation. This study will help to find out whether in situ PS methods in soils are a tool to be potentially included in risk assessment and legislation.

**MO200**

**Bioaccumulation of native and spiked p,p’- DDE by Eisenia andrei in γ-sterilized and non-sterilized soils**

J. Rossetto Martins Zwarg, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX / Faculty of Science, Masaryk University / Faculty of Science, RECETOX

The fate of organic chemicals and their metabolites in soils is often investigated in model matrices having undergone various pretreatment steps that may qualitatively or quantitatively disturb results. Presently, effects associated to γ-irradiation, spiking and dwelling of earthworms were studied in field-contaminated soils (sterilization after contamination) and freshly spiked (sterilization prior to contamination) soils for the case of 1,1-dichloro-2,2-bis(p-chlorophenyl) etylene (p,p’-DDE). Changes in its sorption and bioavailability were linked to the changes in soil organic matter (SOM) chemistry measured by Diffuse Reflectance Infrared Fourier Transform (DRIFT) spectroscopy. Qualitative interpretation of obtained DRIFT spectra revealed changes in SOM chemistry manifested in a reduction of relative intensities of aliphatic moieties (sterilization), in bands of hydroxyl, aromatic, and aliphatic moieties (spiking), and of reduction in bands of aromatic accompanied by an increase of aliphatic moieties (earthworms dwelling). Using DRIFT, changes induced by spiking and earthworms were noted to be more pronounced compared to sterilization. The variation of bioaccumulation factors (BAFs) of native and spiked p,p’-DDE in sterile and nonsterile soils was limited to a factor of 1.5., depending on the incubation time and the particular approach used for BAF calculation. Despite the absence of quantitative effects of γ-irradiation on p,p’-DDE bioaccumulation, the uptake kinetics were shown to vary between
non-stere and sterile soils. Sterilization appeared to increase uptake rates and reduce the influence of p-pDDE-soil contact time on bioaccumulation. These effects might be attributed to the effects of γ-irradiation on SOM chemistry alone or in combination with earthworms. Following our findings, γ-irradiation can be recommended as a relatively non-destructive method that is not expected to significantly affect risk assessment of bioaccumulative chemicals. However, in mechanistic studies the possible side-effects brought about by γ-irradiation should be taken into consideration.

**MO201** Dissipation in soil and bioavailability to earthworms of two fungicides: comparison of laboratory and field experiments S. Bénot, G. Gueguen, S. Barrié, A. Barbé, N. AgroParisTech; C. PELOSI, INRA (Institut National de la Recherche Agronomique)

The pesticide fate in soil is currently studied through laboratory experiments, using homogenized soil and controlled incubation conditions. However, the representativeness of such experiments is questionable regarding to field conditions, i.e., soil heterogeneity, vegetation cover and climatic variations. Upon the few studies providing simultaneously under-field and laboratory, the pesticides persistence and/or sorption on soil were evaluated as different; thus bioavailability could also be different. This study aimed at comparing the dissipation and the bioavailability of dimoxystrobin and epoxiconazole (two fungicides used in the commercial formulation of Swing®) in a loamy soil and in earthworms under laboratory and field conditions. Field experiments were conducted in a meadow located in Versailles (France) on 100 m² plots. The field soil and earthworms were regularly sampled after the treatment, over one year (April to April). Laboratory experiments were performed by mixing the fungicide solution with surface soil issuing from the same field, and incubated in dark, at 15°C and constant humidity. In both cases, four replicates were performed using the recommended Swing® dose, extra doses adapted to observe ecotoxicological effects and controls. The dimoxystrobin and epoxiconazole concentrations in soil were determined by an exhaustive extraction method and to evaluate their availability, with a mild method engaging hydroxypropyl-β-cyclodextrin. At the same time, the bioavailability of the two fungicides was evaluated by determining their concentrations in exposed earthworms Aporrectodea icterica and Aporrectodea caliginosa. All analyses were performed by UHPLC-MS/MS. Under field conditions and five days after pesticide application, only 10% to 45% of pesticide residues were measured in topsoil, with high heterogeneity between replicates. After one month, the concentrations in soil increased, probably due to a plant-soil transfer. By contrast, applied dose was observed at initial time under laboratory conditions. For later dates and in both cases, dissipation was observed. The available fraction showed homogeneous rates under both conditions; there is a highly heterogeneous pesticide fate in soil however, the ratio of available/total concentrations showed the same trend of fate for the two tested substances. The bioavailability of the two fungicides was also different between field and laboratory conditions in terms of heterogeneity.

**MO202** Experimental assessment of specific plant uptake factor of 1,2,4-triazole with different concentrations in wheat R. Faraldo-Alonso, Innovative Environmental Services (IES) Ltd / Plant Metabolism; E. Esteban, Universidad Autónoma de Madrid / Agricultural Chemistry and Food Science; S. Hoger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; D. Williams, Innovative Environmental Services IES Ltd / Plant Metabolism

Environmentally significant risk assessment decisions in EU for Plant Protection Products (PPP) regulation are based on information obtained from Environmental Fate models. Such models (e.g., FOCUS PEARL and PEMETO) attempt to quantify the potential for movement of pesticides and their metabolites to ground water and require data derived from experimental studies based on validated guidelines. Currently, guidelines detailing degradation and absorption processes of pesticides and their metabolites in soil do not accurately account for uptake by plants via root system, with plant uptake compartments only being given a default value. As plant uptake affects the environmental availability of these substances, accurately quantifying this effect is a crucial result in the environmental risk assessment. The plant uptake describes the process of translocation of dissolved compounds in the soil pore water to the plant via the transpiration stream and it can be described using the plant uptake factor (PUF) – uptake into shoots and roots – or the transpiration stream concentration factor (TSCF) – uptake into shoots. Recent work by the ECPA/IVA Working Group “Plant Uptake Factor” has produced a draft working protocol designed to experimentally determine the uptake of active substances as well as metabolites via plant roots. The purpose of the present study was to obtain reliable substance-specific plant uptake data – with different root zone exposure concentrations – using the study design proposed in draft working protocol. The set-up of the experiment was chosen to enable optimal growth of the test plants – wheat seedlings – grown in a hydroponic system under controlled environmental conditions. At BBCH 13 (3 leaves unfolded) **Cu**-labeled 1,2,4-triazole was spiked into the hydroponic solution at different concentrations and the plant root system was exposed for 8 days. Mass balance – calculated from the sum of radioactivity found in the hydroponic solution, root wash plus roots and shoot tissue – and transpiration – calculated gravimetrically – were determined. The experimental data obtained were used to calculate uptake parameters – PUF and TSCF – according to the formulas mentioned in the literature.


Traditionally, partition coefficients of environmental concern, including bioconcentration factors (BCF) and soil or sediment sorption coefficients, are predicted using approaches based on simple linear relationships with the octanol/water partition coefficient (Kow). Recently, more sophisticated prediction models have been developed and applied, including LFER approaches. Such approaches allow distinguishing between separate uptake mechanisms. However, this requires data on distinct partitioning processes, which are rather scarce. For theoretical models without the need for additional experiments, the partition coefficients for these separate processes have to be estimated. While these coefficients basically could be roughly estimated from Kow, the more sophisticated LFER equations, as known from Abraham models, are preferred for such predictions. The and the respective protein concentration for six species, used 12% at 0.06%, 14.7%, 2.86% and 0.31%. The results of sediment characterization showed that the material, composition, surface area and adsorption capacity were significant different among species with different particle size, and adsorption capacity increased with decreasing particle size. In addition, the desorption rates of cymethrin measured by Tenax extraction decreased with decreasing particle size, but that of HOCs was observed to increase with decreasing particle size. The different desorption rates of cymethrin in different particle-size sediments may influence the freely dissolved concentrations in sediment porewater, and subsequently bioaccumulation potential and toxicity.

**MO205** In vitro assay of bile salts on polycyclic aromatic hydrocarbon (PAH) bioaccumulation by zebrafish (Danio rerio) Y. Zhai, X. Xia, School of Environment, Beijing Normal University; X. Xiong, School of Environment, Beijing Normal University / School of Environment; L. Yang, X. Guo, School of Environment, Beijing Normal University

Hydrophobic organic compounds (HOCs) tend to be associated with suspended particles in surface aquatic systems, however, the bioavailability of HOCs on suspended particles to fish is not well understood. In this study, a passive dosing device was used to control the freely dissolved concentration of polycyclic aromatic hydrocarbons (PAHs) including fluoranthene and pyrene, and the influence of particle-associated PAHs on their bioaccumulation by zebrafish was investigated. Results showed that the body burden of PAHs in the zebrafish including the digestive tract (without the head part) were higher than that in the zebrafish excluding digestive tract at the beginning of PAH bioaccumulation, and lower after two day bioaccumulation. The difference may be caused by the effect of PAHs associated with particles in the digestive tract. When PAHs on suspended particles were ingested and they were mainly stored in the digestive tract of zebrafish in the beginning of the bioaccumulation; because the bioavailability factors of PAHs in zebrafish were higher than the partition coefficients of PAHs in suspended particles, the concentrations of PAHs in zebrafish excluding digestive tract were higher than that in zebrafish including digestive tract in the later bioaccumulation.
process. Suspended particles promoted the uptake and elimination rate constants of PAHs to zebrafish body excluding head and digestive tracts. The uptake rate constants with 0.5 g/L-suspended particle were approximately twice that without suspended particles, and the body burden in zebra fish increased by 16.4% - 109.3% for pyrene and 21.8% - 490.4% for fluoranthene during the first 8-d exposure. The findings from this study indicates that PAHs on suspended particles are partly bioavailable to zebra fish and particle ingestion is an important route in PAH bioaccumulation. Therefore, it is important to consider the bioavailability of HOCs on suspended particles to improve ecological risk assessment.

MO206 Methods for Deriving Site-Specific Relative Bioavailability Factors from Ambient Bioavailable Fractions B.H. Maee, ARCADIS; N.D. Forsberg, Arcadis U.S., Inc. / Environmental and Molecular Toxicology; A.K. Meyer, United States Army Corps of Engineers / Huntsville Center

The U.S. Department of Defense is responsible for the environmental restoration of properties that were formerly used for firearm training ranges. Remnants of spent shell casings and empty shells were determined to be a source of polycyclic aromatic hydrocarbons (PAHs) at these sites based on results from surface soil analyses and historical information demonstrating that spent shells were commonly prepared using coal pitch as a binding agent. It was hypothesized that the nature of the coal tar pitch/limestone matrix of the spent fragments reduces the oral bioavailability of PAHs compared to that seen in animal studies using pure benzo(a)pyrene in solution added to diets. To test this hypothesis, soil samples were collected from the two sites to provide a range of PAH concentrations. Female B6C3F1 mice were fed diets amended with soil or soil extracts at a rate of 5% in the diet for fourteen days. For benzo(a)pyrene (BaP), the fraction of total dose excreted in the urine (FUE) was determined for the soil- and soil extract-amended treatment groups. The Relative Bioavailability Factor (RBAF) is the ratio of the FUE in animals treated with soil over those animals treated with soil extracts of soil. Because each soil sample was tested in four cages of mice (two for soil and two for soil extract), there are different ways of computing the RBAF of each soil and the grand RBAF for the site. Pairwise RBAFs will be compared to the RBAF resulting from the regression approach, and the regulatory precedent for the regression approach will be presented.

MO207 Accurate determination of adsorption coefficients for low adsorbing compounds - from experiment to result evaluation T.J. Richter, BASF SE, Agrarzentrum Limburgerhof / APD; T. Richter, BASF SE Agrarzentrum Limburgerhof / Global Product Safety and Registration; K. Platz, BASF SE Agrarzentrum Limburgerhof / Environmental Fate Modeling; A. Immer, Eurofins Agroscience Services EcoChem GmbH; M. Traub, Eurofins Agroscience Services EcoChem GmbH / Environmental Fate

The determination of adsorption coefficients is a critical key parameter for the assessment of the leaching properties of low adsorbing compound’s through the vertical soil profile. In case of expected low adsorption of a chemical compound, several experimental preconditions need to be considered to enable accurate adsorption parameter determinations: (1) An initial soil/solution ratio of 1/1 and (2) the liquid phase needs be removed as completely as possible from the soil phase upon completion of the equilibrium. An experimental approach was developed and optimized allowing the efficient separation of the soil and liquid phase by centrifugation through the soil itself and a filter/frit system. Determination of distribution coefficients is done based on the direct method, hence extraction and analysis of the soil phase as well. Apart from the optimized experimental approach the evaluation is addressed. This includes the elimination of any apparent sources of experimental random errors e. g. by suitable outlier tests. Possible systematic errors have been addressed by the experimental design/data evaluation itself leading always to an underestimation of obtained adsorption parameters. The data evaluation includes the calculation of adsorption coefficients (e. g. Kf) and of p-values with p=Kf (msol/misolution); note: mol/mol/solution after phase separation. If p<0.3, reliability of obtained Kf values is given according to “EFEA, 2017. Technical report on the outcome of the pesticides peer review meeting on the OECD 106 evaluators checklist”. If p<0.3, additional considerations are necessary, e. g. suitable statistical tests, in order to evaluate data quality and to demonstrate significance of the adsorption coefficients. Finally, fit quality as well as upper and lower 95 % confidence intervals of Kf and Koc from isotherms are derived. By reference to examples, data evaluation for cases with p values > and < 0.3 are presented indicating possibilities of that approach.

MO208 Evaluation of the swimming behavior and tactic response to atrazine of the Pseudomona sp. strain ADP L. Rolando, Instituto de Recursos Naturales y Agrobiología de Sevilla / Water Research Institute; A. Barra Caracciolo, National Research Council / Water Research Institute; J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiología / Agroquimica y Conservacion del Suelo

Atrazine, an herbicide used to control grassy and broadleaf weeds in sugarcane, wheat, corn, sorghum, and corn crops. Although since 1992 in European Union Countries it has been banned owing to its toxicological effects, it remains one of the most consumed worldwide pesticide with annual consumption of about 70,000-90,000 tons. Atrazine removal from the environment depends on abiotic (photolysis and hydrolysis) and above all biotic degradation. The latter can be significantly affected by the herbicide bioavailability. The behavioral reactions of bacteria are rarely included in the biological assessment of contaminants ecotoxicity. For this reason, we investigated the swimming behaviour and tactic response of the motile atrazine-mineralizing bacterium Pseudomonas sp. strain ADP to different concentrations of the herbicide in a laboratory experiment. The tactic response was assessed by a chemical-in-capillarity method and an inverted capillary assay for the repellent reaction in association with microscopic observations. The swimming behaviour was evaluated by a computer motion analysis software (CellTrack). We observed attraction responses at relatively high concentrations of the chemical, including at water-saturating concentrations. We also noticed that atrazine can elicit a negative tactic response at low concentrations. We also observed that the swimming patterns of Pseudomonas sp. strain ADP was fitted with 28 days of the data was non-parametric, but by increasing using density. The physiological relevance of the chemioattraction to pollutants lies in the fact that these compounds serve as carbon and energy sources. The overall results suggest that we can use the behavioral responses of motile bacteria as a useful method to estimate pollutant toxicity at ecologically relevant concentrations. The bacteria behavioral assay on pollutants can be an alternative or complementary method to the current ones, because it is a high sensitivity and visualization method.

MO209 The influence of biochar on the toxic effects of imidacloprid to the lifecycle parameters of Eisenia fetida L. Parinet, Animal Research Institute; P. Foucart, University of the Free State / Zoology and Entomology; P.M. Leeto, University of the Free State / Department of Zoology and Entomology

Imidacloprid is an organic active ingredient for various insecticides used to kill a number of biting and sucking insect pests. As a soil amendment, it can enhance sorption and reduce the bioavailability of organic contaminants. Earthworms are important soil promoters and provide various benefits to plants and they are too sensitive to various pollutants, thus they are relevant indicators of environmental change. The current study aimed to assess if biochar has the ability to decrease the effects of the toxicity of the agro-insecticide imidacloprid (IMID) to earthworms. Cocoon laid by earthworms that had never been in contact with any toxicant were exposed to biochar-amended and non-amended aqueous solutions of IMID for a period of 28 days. The data was non-parametric, but by increasing using density. The Kruskal-Wallis ANOVA followed by Dunns’ test. The level of significance was set to be p < 0.05. The results revealed that the effects of IMID on hatching success were only significant at the highest concentration of 400 mg/L. These findings indicate that the recommended field concentration of IMID (400 mg/L) has the potential to prevent cocoons of earthworms such as E. fetida from hatching. This suggests that IMID could lead to decrease population growth rate or complete population collapse in such invertebrates.

MO210 Chloride elimination kinetics in ewes M. Saint-Hilaire, Université de Lorraine / Agroquimica y Conservacion del Suelo; J. Thomé, Université de Liège ULg / LEAE Université de Lorraine  UL; J. Parinet, University of Lille / LEAE-CART; C. Adam, University of Lille / LEAE-CART; J. Parinet, University of Liège / LEAE-CART; C. Parmet, University of Liège / Unité PBM; C. Feidt, Université de Lorraine / UFR AGRO; J. Parinet, ANSES / Unité PBM

Chlordecone (CLD) is an organochlorine pesticide used from 1972 to 1993 against weeds in banana, tobacco, and wheat, conifers, sorghum, and corn crops. Although since 1992 in European Union Countries it has been banned owing to its toxicological effects, it remains one of the most consumed worldwide pesticide with annual consumption of about 90,000 tons. Atrazine removal from the environment depends on abiotic (photolysis and hydrolysis) and above all biotic degradation. The latter can be significantly affected by the herbicide bioavailability. The behavioral reactions of bacteria are rarely included in the biological assessment of contaminants ecotoxicity. For this reason, we investigated the swimming behaviour and tactic response of the motile atrazine-mineralizing bacterium Pseudomonas sp. strain ADP to different concentrations of the herbicide in a laboratory experiment. The tactic response was assessed by a chemical-in-capillarity method and an inverted capillary assay for the repellent reaction in association with microscopic observations. The swimming behaviour was evaluated by a computer motion analysis software (CellTrack). We observed attraction responses at relatively high concentrations of the chemical, including at water-saturating concentrations. We also noticed that atrazine can elicit a negative tactic response at low concentrations. We also observed that the swimming patterns of Pseudomonas sp. strain ADP was fitted with 28 days of the data was non-parametric, but by increasing using density. The physiological relevance of the chemioattraction to pollutants lies in the fact that these compounds serve as carbon and energy sources. The overall results suggest that we can use the behavioral responses of motile bacteria as a useful method to estimate pollutant toxicity at ecologically relevant concentrations. The bacteria behavioral assay on pollutants can be an alternative or complementary method to the current ones, because it is a high sensitivity and visualization method.
values were not significantly different (P > 0.05). Thus, it was possible to conclude that CLD toxicokinetic of CLD in ewe is linear. In urines, CLD and conjugated CLD/DOH were quantified. By comparing the two way of CLD excretion, feces appears to be the principal route of CLD elimination. Almost 60% of the administrated dose was found in feces and only 2% was found in urines. To conclude, the elimination of CLD in serum of ewe is dose-dependent with the dose. In consequence, the different results obtained in CLD excretion in feces can be extrapolated for different levels of exposure in the range of 0-1 mg/kg BW. This study reveals the CLD metabolism in ewes which was never shown before. The principal route of CLD elimination is via the feces. These results clearly indicate the CLD elimination kinetic in ruminants and will help to decontaminate exposed animals in the French West Indies.

MO211 Development and validation of QuEChERS extraction methods with or without enzymatic pretreatment to analyze chlordecone and its metabolites by HPLC-MS/MS in urine and feces of ewes
M. Saint-Hilaire, Université de Lorraine UL / URAFPA INRA; T. Bertin, C. Inthavong, G. Laviron-Pompaud, T. Guerin, ANSES / Unité PBMB; A. Fournier, Université de Lorraine UL; C. Feidt, G. Rychen, Université de Lorraine UL / URAFPA INRA; J. Parinet, ANSES / Unité PBMB
Chlordecone (CLD) is an organochlorine pesticide used from 1972 to 1993 in the French West Indies to fight against the banana black weevil. It is known to increase the risk of prostate cancer and affect development of the foetus and after birth. Nowadays, this pesticide is no longer used but, because of its high persistence, it still remains in soil. Consequently, farm animals can be contaminated by soil ingestion and this is key issue for French West Indies breeding. Thus, this work tends to collect data about the CLD elimination in ewe so as to propose a decontamination strategy. CLD is mainly eliminated in feces and low amounts of CLD can be found in urines. CLD can be metabolized into chlordecol (CLD/DOH) in humans, pigs and gerbils livers. Then CLD and CLD/DOH can be conjugated by the glucuronoyltransferase. In feces, CLD/DOH was found but no conjugated metabolites were present. In urines, no conjugated metabolites were found although the authors thought they would. Actually, no information about the CLD elimination in ewe is available. These findings results were based on a former extraction method developed in 1980 to analyze CLD and its metabolites in urines and feces. The extraction was performed by liquid-liquid extraction. Quantification of the conjugated metabolites was calculated by difference between a sample with and without enzymatic treatment. The analysis was then performed by gas chromatography hyphenated with mass spectrometry. In order to have an update and more sensitive method, a new development was carried out with this work. The extraction was carried using the QuEChERS methodology which is more and more used in the pesticides field. As no conjugated standards were available an update enzymatic pretreatment was set up. The analysis method was performed by liquid chromatography with tandem mass spectrometry using isotopic dilution given a reliable method. The methods were then validated according to the French standard NF V03-110 and the European Union guidelines. At the outcome of the method development process, we can calculate precisions and the extraction recovery of the different matrices. According to the literature, CLD and CLD/DOH were present in ewe feces. In urines, CLD and conjugated CLD/DOH were quantified. These results highlighted a better sensitivity of the new method and allow proving the CLD metabolism in ruminants which was never made before.

MO212 Organic Contaminants in High Mountain Areas: Where and When to find them??
O. Machate, Helmholtz centre for environmental research - UFZ / Plant and Environmental Science; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; D. Schmeller, Helmholtz Centre for Environmental Research UFZ / Conservation Biology; M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis
Semivolatile organic contaminants (SOC) are well known to undergo atmospheric long-range transport and enrich in remote high mountain ecosystems. To predict the risk for high mountain ecosystems it is necessary to have knowledge of the present contamination and their bioavailability. For this reason, the chemical concentrations of SOC vary vastly in magnitude and spatial distribution within these areas. Mentioned as important drivers of these variations are the change in precipitation and temperature with increasing altitude and the locally prevailing wind patterns. Despite this knowledge, the task to interpret the results gained within studies on the spatial distribution of organic contaminants within high mountain areas remains difficult. To aid future researchers with their assessment this poster tries to condense the key information on fate and behavior of organic contaminants in high mountain areas. Therefore, fate determining variables will be named and the movement and bioavailability of organic contaminants throughout the seasons be described.

MO213 Pesticide occurrence in different agricultrical matrices (honey bees, wax and pollen)
P. Calatayud-Vernich, M. Andrés Costa, Universitat de Valencia / Environmental and Food Safety Research Group; F. Calatalyud, E. Simó, Agrupación de Defensa Sanitaria Apícola (apiADs); Y. Pico, University of Valencia / Medicine Preventive Sprayed crops with pesticides are visited by honey bees during pollen and nectar collecting process. Pesticides are transported inside the hive, where both, agrochemicals from agriculture and compounds used in-hive against varroosis by beekeepers are accumulated in wax, pollen and honey bees. Samples of honey bees (45), wax (43) and pollen (45) were obtained from 45 different apiaries located in Spain. The samples were extracted by a slightly modified QuEChERS procedure depending on the matrix, and then screened for 58 pesticides and its degradation products by liquid chromatography mass spectrometry (LC-MS/MS). The target analytes were chosen based on their potential toxicity to honey bees and their widespread use in plant protection or in the bee hive against varroa mite. Wax and pollen were the most conventional matrices and exhibited a wide contamination by pyrethroids and organophosphates. Beeswax lipophilic nature and its lowest replacement rate in the hive are responsible of its highest pesticide content. Acaricides used in beekeeping such as coumaphos, chlorfenavinphos, amitraz and fluvanilate were the most frequently detected pesticides in wax. Some pesticides used in crops as organophosphate chlorpyrifos were detected in lower frequencies and concentrations. Pollen contamination pattern was similar to wax matrices. Acaricides applied in beekeeping were the most frequent and with the highest concentrations. Neonicotinoid acetamiprid and organophosphates chlorpyrifos and dimethoate were detected in pollen samples. Both insecticides are sprayed in crops and deposited on the pollen grains, which are transported to the hive during the foraging activity of the honey bees. Honey bee samples were less contaminated, although some acaricides were detected. This fraction was calculated in the product of the concentrations detected in the matrices analyzed, honey bee colonies health could be compromised. Assessing pesticides content in these three different agricultural matrices at the same time is a useful tool to understand the magnitude of honey colonies exposure to toxic compounds, which is one of the main causes of the progressive decline in honey bee colonies around the world.

MO214 Adaptation requirements for the use of measured BCF for a realistic risk assessment of organic chemicals.
N. Pucheux, INERIS; S. ANDRES, INERIS / Toxicological Ectotoxicological Assessment of chemical Substances
One of the main factor in the secondary poisoning risk assessment is the bioavailability of potentially hazardous organic chemicals, especially in the case of soil contaminated with persistent organic pollutants. In the context of the TROPHÉ project, the transfer of PCBs and PCDD/Fs to plants and invertebrates has been studied: BCF in several plants and in earthworm has been measured and different models have been developed to calculate primary BCF. A second approach is to calculate primary BCF depending on the glaucuronoyltransferase. In feces, CLD/DOH was found but no conjugated metabolites were present. In urines, no conjugated metabolites were found although the authors thought they would. Actually, no information about the CLD elimination in ewe is available. These findings results were based on a former extraction method developed in 1980 to analyze CLD and its metabolites in urines and feces. The extraction was performed by liquid-liquid extraction. Quantification of the conjugated metabolites was calculated by difference between a sample with and without enzymatic treatment. The analysis was then performed by gas chromatography hyphenated with mass spectrometry. In order to have an update and more sensitive method, a new development was carried out with this work. The extraction was carried using the QuEChERS methodology which is more and more used in the pesticides field. As no conjugated standards were available an update enzymatic pretreatment was set up. The analysis method was performed by liquid chromatography with tandem mass spectrometry using isotopic dilution given a reliable method. The methods were then validated according to the French standard NF V03-110 and the European Union guidelines. At the outcome of the method development process, we can calculate precisions and the extraction recovery of the different matrices. According to the literature, CLD and CLD/DOH were present in ewe feces. In urines, CLD and conjugated CLD/DOH were quantified. These results highlighted a better sensitivity of the new method and allow proving the CLD metabolism in ruminants which was never made before.

MO215 Assessing risks from PBT substances in surface waters: possible alternatives to biota monitoring?
The Water Framework Directive (WFD) requires waterbodies to be at ‘good ecological status’ by meeting Environmental Quality Standards (EQSs). Normally, these are expressed as concentrations in water but in recent years standards expressed as critical concentrations in the flesh of aquatic biota (biota EQSs) have been developed for some chemicals that are persistent, bioaccumulative and toxic (PBT) with the aim of protecting predators and humans from chemical exposure via the foodchain. Biota standards are now set for 11 PBT substances or groups of substances, requiring Members States to set up monitoring regimes to assess the risks to surface waters. Biota monitoring (fish or invertebrates, depending on the substance of interest) is the most relevant sampling matrix but it is destructive, and suitable biota cannot always be found where sampling is required. As a result, the coverage offered by biota sampling programmes is much less extensive than
sampling of water. This means that extrapolation to unsampled waterbodies is needed but this is highly uncertain, so national risk assessments are difficult to achieve. This study explores alternative matrices to biota sampling, focussing on sampling of (a) whole water and (b) the dissolved fraction estimated from passive sampling. We describe studies in which chemical analyses of whole water and passive samplers for a range of PBT substances are compared with water thresholds but the dissolved fraction was more variable. These results are compared with those made using biota samples taken from the same locations in UK surface waters. The utility of these matrices as possible alternatives to biota monitoring is examined, and their implications for future risk assessment is discussed.

MO216 Risk Associated with Alternative Cleaning Method for Carrot
P. Abara, Federal University of Technology Owerri / Department of Biological Sciences; L.A. Adjeroh, C.O. Ezea, Federal University of Technology Owerri / Biology; A.C. Udebuani, Federal University of Technology / Department of Biotechnology

ABSTRACT Risk Associated with Alternative Cleaning Method for Carrot
Introduction Carrot is a nutritional root vegetable which is loaded with beta carotene, a precursor of vitamin A. It is necessary to wash carrots in order to remove soil and other foreign materials before eating either raw or in processed form (Moos et al., 2002). It is common practice nowadays to soak carrot in detergent before washing to achieve better cleaning. Some components of detergent are toxic (HERA, 2013; Chukwu et al., 2015). The aim of this study is to evaluate the detergent residue accumulated in carrot exposed to detergent. Methodology The first stage involved distribution of questionnaires to determine the popularity of the use of this chemical substance in washing carrot before selling to consumers. The second stage involved soaking 2 kg of fresh carrots in five increasing concentrations of Detergents 1 and Detergent 2. The carrots were soaked for 20, 40 and 60 minutes. After which they were grounded and analyzed using the bicrometric method as described by IPAN (2005). Results a. 64.29% of the respondents agreed to the use of detergent in soaking before washing. 25.14% do not use detergent in washing their carrots before selling to consumers while 10.57% were indifferent. Anionic Surfactant Residue in Exposed Carrots There was a concentration and time dependent increase (P < 0.001) in the percentage anionic surfactant in the exposed carrots Figure 1: Anionic Surfactant present as Residue in Carrot Washed with Detergent. c. Percentage Cationic Surfactant Residue in Exposed Carrot The percentage cationic surfactants residue increased with concentration and length of exposure. Figure 2: Percentage Cationic Surfactant Residue in Exposed Carrot. Figure 29: Quantity of Detergent Residue in Exposed Carrot. Conclusion The presence of residual amount of detergent in the exposed carrot raises a public health concern as this food item is daily consumed by unsuspecting public. REFERENCES Chuku, E. C., Ogunka-Nnoka, C. U. and Chuku, O. S. (2015). Effect of washing carrot with Omo detergent on the nutrient composition, shelf life, associated fungi and health hazards. Pacesetters/Journal of Scientific Research, 1(1): 1 - 5 Institute of Public Analyst of Nigeria IPAN (2005). Training Manual for 2005 pre-award training workshop. pp 287-288

Environmental risk assessment in time and space - new approaches to deal with ecological complexity (P)

MO218 Uncertainty concepts and misconceptions for landscape scale risk assessment
P. Thorbek; Syngenta / Environmental Safety; M. Hamer, Syngenta / Environmental Safety; K.Z. Travis, Syngenta / Product Safety; A. Raybould, Syngenta
In Europe there appears to be two opposing views on the future of ecological risk assessment of pesticides. One aims to improve ecological realism and move towards landscape scale risk assessments whereas the other aims to simplify and focus on lower tier exposure and effect assessment. To some extent this dichotomy is based on differences in uncertainty perception. Thus, one camp focuses on what we here term “in-situ uncertainty” and therefore holds that higher tiers are more uncertain than lower tiers. The other camp focuses on what we term “extrapolation uncertainty” and therefore holds that higher tiers are closer to real uses in real landscapes than the lower tiers. There is no one right or wrong answer. The risk associated with pesticides in the environment stems from the fact that we are dealing with complex systems. The present scientific thinking assumes that risk is additive and that the resulting risk is the sum of the uncertainties. The present scientific thinking makes it difficult to estimate the contribution of each uncertainty separately. However, we need to be able to do this if we are to make uncertainty analysis more useful for decision making.

MO219 Concept for a regional geospatial landscape analyses to predict site specific vegetation covers
A. Taschki, Research Institute gaiac; G. Lennartz, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; T. Schad, Bayer Ag / Environmental Modelling; T. Preuss, Bayer Ag / Environmental Safety

The spatial pattern of plant communities in the agricultural landscape is depending on land management and the site specific environmental and soil conditions. In vegetation science the composition of plant species and their abundances in dependence on these factors are extensively described. This project follows the hypothesis that if the decisive environmental and soil parameters (soil type, soil temperature etc.) are known it should be possible to predict the vegetation cover and subsequently the composition of plant species on this site. As a starting point the main grassland types of North Rhine-Westphalia and Mecklenburg-Western Pomerania (Germany) were considered and data for vegetation communities, plant species and their frequency and abundance were imported in a PostGIS database. Additionally geospatial data (shapes of grasslands, soil types etc.) were imported in this spatial database. As a second step a matrix of comparisons of soil and environmental parameters was built and calibrated in ‘if-then’ steps with the main preferences of the different vegetation communities. The poster show first prediction results and discuss pro and cons of the concept as well as possible refinements in the future. The supply of data originated from these predictions could be helpful in many facets of risk assessment on a regional scale.

MO220 B-Rice: bird focal species identification in rice paddy
A. Caffi, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health; F. Marchetto, ICPS / Public Health; F. Galimberti, A. Riva, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health; L. Bani, V. Orlioi, Università degli Studi Milano Bicocca / Dipartimento di Scienze dell’Ambiente e della Terra; S. Ubbiali, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health

Pesticide registration in EU (Reg. 1107/2009 EC) requires appropriate risk assessment for non-target organisms including birds. The European Food Safety Authority developed a Guidance Document (GD) to conduct the risk assessment considering a series of exposure scenarios from a combination of crops and growth stages, selecting relevant species at the lower steps of a tiered approach. The actual GD doesn’t include scenarios for pesticide applications on rice; nowadays bird risk assessment is generally performed considering rice as the other cereals. Rice paddy is highly impacted by two cultivation conditions: the dry one, comparable to bare soil scenario (as common cereal), for which groups of species are equivalent to those identified for the actual risk assessment and already reported in GD; the flooded one, typical of aquatic environments and wetlands, representative of a unique exposure scenario not yet considered in the employed GD. The aim of this work is to characterize areas of rice growing in Northern Italy, which are representative for humid scenarios (via GIS approach), identify and link the relevant focal species to them. A review of the grey literature will be performed in order to estimate presence, abundance, dominance and diet of species associated to North of Italy rice paddies. Indicator and generic focal species will be proposed for the lower tiers of a Specific Rice Pesticide Risk Assessment and suggested as potential model for the Southern European Zone.

MO221 A process-based population model for algae
L. Azevedo, BASF SE, Agrarzentrum Limburgerhof / Global Toxicology; M. Hubeck, BASF Corporation; P. Janz, BASF SE Agrarzentrum Limburgerhof

EFSA’s guidance document for the risk assessment of edge-of-field aquatic organisms recommends a maximum of 8 weeks for the ecological recovery option (ERO) of aquatic organisms in a risk assessment for plant protection products (PPP). Here, we propose a process-based model for algal abundance to simulate effects and recovery of algal populations over time following exposure to PPPs. The model integrates the main processes driving algal cell growth, such as (1) toxicity of the PPP and (2) growth conditions due to dry or humid climate conditions, nutrient availability, grazing and competition for resources, and density dependence. This model also makes a significant step towards full compliance with EFSA good modelling practices, whereby models for regulatory risk assessments should include validation, and sensitivity and uncertainty analyses. In this poster, the formal model as well as sensitivity and uncertainty analyses are depicted. We also employ empirical data from mesocosm studies conducted for a selective herbicide for model validation.

MO222 Population dynamics of a soil arthropod simulated using an individual based population model and established fate model data
D. Nickisch, T. Wittwer, Rajnet, P. Janz, BASF SE Agrarzentrum Limburgerhof

The prediction of concentrations of plant protection products in soil, surface and ground water using chemical fate modelling is established since decades and applied in European environmental risk assessments (ERA). Many issues, concerns
and limitations were discussed and adequately addressed by scientific communities, applicants and authorities. As a result, a variety of accepted tools are now available for exposure assessment. In contrast, population modelling approaches used in ERA for effect assessment in ecotoxicology are still at a relatively early establishment stage. In this respect, although effect modelling is recognised as a beneficial tool for addressing ecological realism to ERAs, EFSA has so far not published any guidance document. Population modelling is at least mentioned in several EFSA (draft) guidelines and opinions as a refinement option. However, so far, outcomes of submitted effect modelling approaches in ERAs are not often considered by authorities. Many of the available models deal with protection goals that address field populations. Therefore, effect models are often stochastic and spatially explicit. This however makes these models more complex in comparison to the established deterministic exposure models and therefore considerable effort is needed for their verification, validation and comprehensive communication.

Since effect modelling for ERA aims to predict effects on populations of the model organisms which arise from environmental exposure, we find it meaningful to use, in ecological models, the relevant data from the established fate models. This can make the modelling approaches more harmonised and probably would enhance their acceptability. We illustrated the usability of data on environmental conditions which agree with the established fate models and could as well demonstrate the implications of different environmental conditions on springtail populations. For this purpose, we used an individual based population model which represents the life-cycle of springtails in a temperature dependent framework. Specifically, we calculated soil temperature series with the groundwater model Pearl. Further, we used soil moisture content as a function of meteorological data and a variable pre-wetted soil moisture series from JRC databases. Those series characterised the environment in the springtail model and drove the temperature-dependent model processes.

M0223 Dynamic modelling of fluxes of weathered polychlorinated biphenyls (PCBs) in soil: column experiments vs. modelling approaches in realistic environmental conditions
V. Vitale, University of Insubria; E. Terzaghi, University of Insubria (Como) / Department of Science and High Technology, Como; M. Morselli, A. Di Guardo, University of Insubria / Department of Science and High Technology

A column leaching experiment was performed to simulate realistic conditions that may be representative of different environmental scenarios and evaluate their influence on mobility and transport associated to dissolved organic carbon (DOC) and fine particles of aged polychlorinated biphenyls (PCBs) (PCB 28, 52, 101, 153, 138, 180, 209) in soil obtained from the Brescia-Caffaro contaminated site. The measured concentrations in leachates were compared to the results of simulations performed with a dynamic speciation-soil model (SoilPlus model) to investigate the predictive ability and the improvements needed to obtain better predictions. The variables taken into account were: 1) contact time between soil and water, 2) DOC content and quality in leaching solutions and in soil pore water, 3) fine particle-mentioned transport, 4) temperature (and its influence on endogenous DOC production), 5) soil saturation conditions. These conditions were evaluated in a dynamic leaching experiment performed over a variable pre-wetted moisture content times (2, 5, 7, 48 days), using leaching solution with differ DOC content (tap water vs. a solution prepared with commercial humic acid), at different temperature (25 °C vs. 15°C) and in saturated vs. pseudo field capacity conditions. Results indicated that equilibriation time determined differences in measured PCB concentrations up to a factor of 8, probably due to the lack of equilibration with the endogenous DOC in DOC saturated conditions. The addition of endogenous DOC increased mobility (up to a factor of 4) especially for brief contact time (non-equilibrium conditions) and within the Log Kow range 6-7.5. Samples leached at room temperature showed concentrations up to a factor of 9 higher in comparison to samples collected at lower temperature probably because of the different amount of endogenous DOC produced. Samples kept in pseudo field capacity conditions for seven days and then flushed resulted in about double the concentrations of the samples flushed in saturated conditions with a brief contact time, showing that drying-wetting cycles may determine concentration peaks. These trends were not caught by the model predictions as well as the relevance of the transport associated to fine particles, pushing for incorporation of this dynamic in model.

M0224 Assessing the trait-based ecological vulnerability of aquatic invertebrates for phenol

J. Park, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering; S. Kim, Gwangju Institute of Science and Technology; J. Kim, S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering
Recently, there has been considerable concern about the chemical accidents as usage and manufacture of phenol have increased. Phenol is harmful to living organisms and its exposure can cause ecological and economical damages. Therefore, it is necessary to prepare for possible chemical accident of phenol. The Korean government designated phenol as the accident preparedness substance and required to assess and manage the ecological risk of phenol. This study aimed to find the ecological risk at the scenario that phenol exposed to freshwater bodies in Korea. In particular, the vulnerability of aquatic invertebrates was explored to consider not only individual organisms also their populations. Vulnerability integrated the exposure, sensitivity, and recovery of the ecosystem by considering various traits (e.g., body length, food preference, toxicological sensitivity, recovery strategy, etc.). The traits were reviewed by published data or open sources, and respective scores were assigned by using multi-criteria analysis which transformed them into numerical values. The toxicological sensitivity was derived by indirect prediction based on traits because precise data was not possible. The results figured out the vulnerable invertebrates for phenol in Korean freshwater. In addition, the vulnerable species showed that the consideration of only sensitive species would not be great ecological risk assessment and management. This work was supported by Korea Environmental Industry & Technology Institute (KETI) through “The Chemical Accident Prevention Technology Development Project”, funded by Korea Ministry of Environment (MOE) (No. 2016MO0197001).

M0225 Assessing and managing food-web effects of Plant Protection Products
K. Swarowski, German Federal Environment Agency (UBA) / Department IV plant protection products; H. Hötker, Nature And Biodiversity Conservation Union (NABU) Germany / Michael-Otto-Institute; R. Oppermann, Institute for Agro-ecology and Biodiversity (IFAB); C. Bruehl, University of Koblenz-Landau / Institute for Environmental Sciences; S. Matezki, German Environment Agency UBA; J. Wogram, German Environment Agency UBA / Department IV plant protection products

Assessing impacts on biodiversity needs to integrate indirect effects (trophic chain interactions, also referred to as food-web effects or effects on biodiversity). Plant protection law requires protecting biodiversity and data requirements for Plant Protection Product (PPP) active substances (Regulation EC 283/2013) as well as indirect effects to be considered in the assessment of the impacts of pesticides on biodiversity. The relevance of indirect effects of PPPs in addition to the standard risk assessment and provide suggestions to risk managers on how to mitigate them. Due to the large variation in food-web compositions and spatial and temporal implications, we do not consider it possible to achieve a representative and realistic estimate of indirect effects by means of mechanistic models. Instead, we suggest a simple empirical model to complement current risk assessment. However, implementing a risk assessment scheme for an additional subject of protection would not be feasible without offering solutions on how to manage the assessed risk. Otherwise, an adverse outcome of the assessment would inevitably lead to non-authorisations. To solve this conflict, we put forward an approach to manage risk by means of compensating food web effects. In practice, compensation is established by ecological compensation areas such as flowering margins, set-asides and beetle banks infield. To make most out of existing types of suitable measures and to enable a maximum of freedom of choice to farmers, we provide a points rationing scheme to categorise the individual measures with regard to their value for supporting in-field biodiversity (and thus to compensate for indirect effects of PPPs).

M0226 Compensating for ecological risks of pesticides
S. Matezki, K. Swarowski, German Environment Agency UBA; J. Wogram, German Environment Agency UBA / Department IV plant protection products

Current environmental risk assessment (ERA) of pesticides overlooks a considerable part of existing risks and consequently fails to protect the environment from pesticide effects in toto. Examples of such blind spots are risks to field-dwelling species including wild pollinators, amphibians and farmland birds as well as indirect food web effects. To address these ecological risks, we developed a tool well described and highly relevant for the achievement of the legally defined environmental protection goals, eliminating these blind spots in the risk regulation has failed so far. The ‘indirect effect’-issue is an illustrative example for what we would actually regard as a crisis in environmental risks regulation of PPPs. What we recognize is that progress in ERA notably seems to be hampered for types of risk for which no effective risk assessment models have been established, so that an assessment of such risks would inevitably lead to non-authorizations. To solve this conflict, we wish to put forward a radically new approach in risk management: Compensating adverse effects of pesticides where established methods of risk mitigation fail to prevent them. Once implemented into the iterative process of risk assessment, such new risk mitigation approaches would allow to manage actual risks more adequately than currently possible, thereby preventing an increase of non-authorizations. It has not escaped our notice that our proposal could make excessive higher tier assessments dispensable, thereby helping to solve the problem of the increase of complexity in ERA.
MO228

**Historical control data of the optimized Zebrafish Embryonic Developmental Toxicity Assay (ZEDTA)**

D. van den Oetelaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobor-Kaplon, Charles River Laboratories Den Bosch / GET; M. Beckhuijzen, H. Emmen, Charles River Laboratories Den Bosch / GIT; B. van de Waart, Charles River Laboratories Den Bosch / GET

The ZEDTA is a promising and innovative method with a potential to replace the screening of teratogenicity in animals (rats and rabbits) and is gaining acceptance among scientists and regulators. However, so far no harmonized and validated protocol exists for this test. Therefore, a protocol based on the OECD guideline No. 236, has been developed and optimized by Charles River Laboratories Den Bosch, the Netherlands. Multiple studies were performed using the optimized protocol, which allowed for collection of historical control data on the frequency of malformations, mortality and development of the embryos/larvae exposed to the control treatment. In our protocol, embryos in the blastula phase (2-4 hours post fertilization [hpf]) were selected and exposed to adjusted ISO medium. Twenty four embryos (one embryo per well in a 24 wells plate), were exposed at a temperature of 26°C for a period of 96. Exposure medium was renewed after 48 hours. Development was assessed daily using the Extended General Morphology Score (GMS). Teratogenic endpoints were scored as ‘present’ or ‘absent’ after 96 hours of exposure. The Extended GMS grades the normal development of a zebrafish embryo up to 100 hpf. Assessed endpoints consisted of, but were not limited to: detachment of tail, somite formation, eye development, heartbeat and movement. The maximum score at 100 hpf was 18. Teratogenic endpoints scored during the assessment comprise of malformations of saccule/otoliths, head, heart, tail, yolk, pectoral fins and entire body. Data of twenty experiments were analysed. In total 400 embryos were exposed to control treatment (i.e. adjusted adjusted ISO medium). The average mortality rate in the control treatment was 2.5% which was considered acceptable. In only three experiments a maximum mortality of 10% was reached, which was still considered acceptable. Sixty percent of surviving larvae scored the maximum of 18 points for development, whereas 32% scored 17 points at the end of exposure (100 hpf). The most frequently observed findings were malformations of yolk (3.3%) tail (3.1%), heart (2.3%) and head (1.3%). These findings were observed in 6.4% of surviving larvae only. Analysis of the historical control data shows that the used optimized protocol produces an optimal development rate of exposed embryos and larvae, with minimal mortality and a minimal background malformation rate. This indicates a low level of confounding factors and high reliability of results produced with our protocol.

MO229

**Optimization of the Zebrafish Embryonic Developmental Toxicity Assay (ZEDTA)**

D. van den Oetelaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobor-Kaplon, Charles River Laboratories Den Bosch / GET; M. Beckhuijzen, H. Emmen, Charles River Laboratories Den Bosch / GIT; B. van de Waart, Charles River Laboratories Den Bosch / GET

The ZEDTA is a promising and innovative method with a potential to replace the screening of teratogenicity in animals (rats and rabbits) and is gaining acceptance among scientists and regulators. However, so far no harmonized and validated protocol exists for the ZEDTA. The aim of this research was to optimize the protocol, i.e. examine which combination of exposure parameters is optimal for embryonic and larval development and is at the same time most cost-effective. An optimal embryo condition should yield normal growth and development with minimal mortality and/or malformations. The OECD guideline No. 236 was used as base. In our protocol embryos in the blastula phase (2-4 hours post fertilization [hpf]) are exposed to adjusted ISO medium. The following factors and their combinations were investigated: temperature (26 vs. 28°C), exposure vessels (24 vs. 96 well plates), renewal periods (static (no renewal) vs. semi-static (24 or 48 h renewal)), and use of solvent (0.05% v/v DMSO vs. adjusted ISO medium). Development was scored daily, using the Extended General Morphology Score (GMS). This system grades the normal development of a zebrafish embryo up to 100 hpf. Assessed endpoints consist of, but are not limited to: detachment of tail, somite formation, eye development, heartbeat and movement. The maximum score at 100 hpf is 18. Teratogenic endpoints such as malformations of saccule/otoliths, head, heart, tail, yolk, pectoral fins and entire body were scored as ‘present’ or ‘absent’ after 96 hours of exposure. Mean developmental and teratogenic scores were calculated and used to select the most optimal condition for each factor. Our experiments showed that exposure in 24-well plates at a temperature of 26°C in combination with renewal of exposure medium after 48 hours of exposure produced the most optimal results with the lowest incidence of malformations. Daily renewal of medium provided similar results, but this was less cost-effective. Use of 0.5% v/v DMSO did not produce more malformations or mortality than exposure to adjusted ISO medium.

MO230

**Reliability of ecotoxicological studies in fish**

H. Winnemann, Bavarian Environment Agency; H. Ferling, Bavarian Environmental Agency; G. Dembek, W. Schmidt, W. Koerner, Bavarian Environment Agency; J. Schweiger, Bavarian Environment Agency / Aquatic Toxicology and Pathology

Frequent re-evaluation in ecotoxicology valid bioassays are essential for deriving Environmental Quality Standard (EQS). The generally established biotests using the three trophic levels - algae, invertebrate and fish - according to OECD Guidelines provide in particular the baseline data for the derivation of the EQS. To obtain the most accurate EQS by use of a low assessment factor of 10 data from all three trophic levels including long-term results are required. Depending on the test substance growth inhibition of algae, immobilization of daphnia as well as deformation and death of fish embryos are not necessarily the most sensitive organisms and endpoints. Fish are in many cases the most suitable test organisms to demonstrate effects of e.g. pharmaceuticals with a specific mode of action in vertebrates. Therefore, prolonged toxicity tests with fish are of great importance. However, the study design has to be adapted to specific endpoints according to the pharmacodynamics of the tested drugs. Thus, in planning and implementing this type of study special care must be taken to ensure that the generated data can be used for derivation of EQS. Even though several reporting and evaluation criteria for ecotoxicological studies have been published (e.g. Klümisch, Cred) up to date still numerous studies are available which do not fulfill these criteria and thus have to be excluded in the assessment process. Frequent failure sources include e.g. not statistically significant results, irregularities in the test setup and use of control groups, insufficient number of concentrations tested, missing chemical analysis of test compound concentration in the test water, calculation of toxicological endpoints on the basis of nominal and not real concentrations, or insufficient quality of endpoints. The aim of the presentation is to outline, from our point of view, optimal experimental conditions of prolonged fish tests which can be adapted as a model for other scientific studies, through increasing the scientifically results and considering so far neglected aspects such as possible background contamination of commercially available fish feed frequently used in fish studies.

MO232

**Assessment of the relationship between heavy metal bioaccumulation and biomarker responses in Japanese dace inhabit in heavy metal contaminated river**

H. Takeuchi, Toyo University / Research Center for Life and Environmental Sciences; Y. Iwasaki, National Institute of Advanced Industrial Science and Technology AIST Japan / Research Institute of Science for Safety and Sustainability; D. Kitamura, Toyo University / Graduate School of Life Sciences; Y. Kato, Toyo University / Faculty of Life Sciences; Y. Shimizu, Toyo University / Graduate School of Life Sciences; H. Tatsuta, University of the Ryukyu / Faculty of Agriculture; S. Kashiwada, Toyo University / Graduate School of Life Sciences

The Watarase River, running in the northern Kanto region of Japan, had been severely polluted by heavy metals due to Ashio mining activities from late 1800s to early 1900s (e.g. 20 mg Cu/L in river water in 1897). Although the heavy metal concentrations remarkably decreased since 1960s, the concentrations are still generally higher than those in an unpolluted river, the Omoi River. In previous study, our group investigated the heavy metal accumulation status (Cu, Zn, As, Pb, Cd and Fe) in organs of Japanese dace Tribolodon hakonensis captured from mid reach sites in the Watarase and Omoi River, and also analyzed those river water and sediment concentrations. Water and sediment concentrations of metals at three sites in the Watarase River were generally higher than those in the Omoi River, interestingly, whereas Zn, As, Pb and Cd concentration in liver of Japanese dace in the Watarase River were lower than those in the Omoi River. Additionally, although there were no significant genetic differences between both riverine dace in microsatellite analysis, bile metallothionein (cysteine-rich protein involved in metal detoxification) concentration of dace in the Watarase River was significantly higher than that in the Omoi River. It suggests that the dace inhabit in the Watarase River may have been adapted to metal contamination by biological responses not depending on genetic characteristics. In the present study, for understanding biological response mechanism of dace to the metal contamination, we analyzed multiple biomarkers (such as erythrocyte δ-aminolevulinic acid dehydratase, blood protoporphyrin and hemoglobin concentration, and bile metallothionein concentration) in dace captured in the Watarase and Omoi River, as well as metal accumulation status of those fish. In this presentation, we will show detailed results, and discuss about the relationship between heavy metal bioaccumulation and biomarker responses in riverine fish inhabit in metal contaminated river.
Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental pollutants. The impact of PAH/oxygenated PAH (oxy-PAH) mixtures on nearshore biota is still not fully characterized. To help understand one of the most toxic compounds is benzo[a]pyrene (BP), an oxy-PAH (the ketones of cyclopenta[de]pyrene-4-one and cyclopenta[de]phenanthrene-4-one).

MO233 Endocrine disruption effects of bisphenol S and bisphenol SIP in adult zebrafish (Danio rerio) K. Ji, J. Lee, Yongin University

As alternative compounds of bisphenol A (BPA), bisphenol S (BPS) and 4-hydroxy-4-isopropylphenyl sulfone (BPSIP) are widely used in thermal paper products. These compounds have been detected in human urine samples; however limited information is available on their endocrine disrupting effects. Adult zebrafish pairs (Danio rerio) were exposed to environmentally relevant concentrations (0, 0.5, 5, and 50 μg/L) of BPS and BPSIP for 21 days, and the adverse effects on egg production, levels of sex steroid hormones, and transcription of genes related to hypothalamic-pituitary-gonadal (HPG) axis were investigated. The estrogenic (increase in 17β-estradiol/testosterone [E2/T] ratio) and anti-estrogenic (decrease in total androgenic) effects were commonly observed in zebrafish exposed to both BPS and BPSIP, and males were more sensitive to the adverse effects than females. Although the effective concentration for endocrine disruption was greater than that of BPS, the actions of BPSIP on the steroidogenic pathway were similar to the effects of BPS exposure. The commonalities and differences in the toxicity of BPS and BPSIP can be explained by their chemical structure: the phenolic hydroxyl group is a key structural component responsible for the estrogenic and anti-estrogenic activities of bisphenol analogues. The results of the present study showed that exposure to low level BPS and BPSIP could affect regulatory systems of HPG axis in zebrafish at environmentally relevant concentrations.

MO234 Oxidative Stress Induced by PAH Metabolism: Comparing Three Exposure Routes in Red Drum, Florida Pompano, and Southern Flounder to Dhw substituted arsenic D. Wetzel, Moto Marine Laboratory / ELF, R. Medvecky, C. Miller, M. Main, T.A. Sherwood, Moto Marine Laboratory

The magnitude of the oil and dispersant released during the Deepwater Horizon blowout caused significant immediate, and often lethal, damage to exposed organisms. However, the sub-lethal impacts of the chronic spill on offshore and nearshore fish biota are still not fully characterized. To help understand one of the most significant responses in important Gulf fish species, four different exposure-route experiments, Dhw surrogate oil, contaminated feed, sediments, and seawater, were designed and carried out to examine biological responses of aquaculture reared red drum, Florida pompano, and southern flounder. Environmental pollutants, like polycyclic aromatic hydrocarbons (PAHs) found in crude oil, have the potential to contaminate the antioxidant system of marine organisms. Oxidative stress occurs when there is an imbalance between the production of reactive oxygen species (ROS) and the organism’s ability to detoxify reactive intermediates, such as those generated by metabolism of PAHs by cytochrome P450 (CYP1). Depending on the severity of oxidative stress, this imbalance can lead to DNA damage in a variety of ways, such as oxidized bases, apurinic/apyrimidinic sites (AP sites), single or double strand breaks and DNA adducts. Exposure to PAHs can lead to increase DNA damage, such as those created by AP sites (purine loss) and the formation of DNA adducts, in which PAH metabolites intercalate into the DNA. Total PAH concentrations were analyzed in exposure matrices, as well as fish livers and whole bodies to determine specific dosages. Multiple assessments have been carried out to examine oxidative stress, singlet oxygen, total antioxidant power analysis, 2-Thiobarbituric Acid Reactive Substances analysis, GSH/GSSG ratio determination, AP site quantitation, and 8-OhdG quantitation. Evidence of oxidative stress will be discussed considering multiple pathways of exposure, and resulting impacts in terms of biological and ecological implications.

MO235 Impact of PAH/oxy-PAH mixtures on heart development in zebrafish V. Cinha, K. Dreij, Karolinska Institutet

Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental pollutants that have been widely studied. Oxygenated PAHs (oxy-PAHs) are also found in the environment and are emitted from the same primary sources as PAHs but also can be formed through secondary oxidation of PAHs. However, relatively little is known about their environmental fate and toxicity. The aim of this work was to determine the effects of binary PAH/oxy-PAH mixtures on cardiac development in zebrafish (Danio rerio) embryos (ZFEs). ZFEs (24 hpf) were exposed to a dose range of single PAH (benzo[a]pyrene, BP), oxy-PAH (the ketones of cyclopenta[de]pyrene-4-one and 6H-benzof[cd]pyrene-6-one) or their binary mixture for 4 days. After exposure, ZFEs were observed for effects on heart development, heart rate and blood flow. Samples were also collected for gene expression analysis. The results showed abnormal cardiac development, such as formation of string hearts where exposed to 6H-BP and BFLO in combination with BP was more potent than single exposures. The heart rate and blood flow was significantly decreased, in a dose-dependent manner, in ZFEs exposed to 6H-BP alone and in combination with BP. With the other oxy-PAHs, a decrease in the heart rate was observed, however in a non-monotonic response to the treatments. Blood flow was also decreased but only for BFLO and 6H-4P in mixture with BP. Gene expression analysis showed significant up-regulation of genes in vivo and in vivo toxicokinetics of polyaromatic hydrocarbons (PAHs) is also found in the freshwater systems of the valley of Mexico, on juveniles of zebrafish (Danio rerio) following PAH mixture exposure to PAHs alone in inducing cardiotoxicity, except in the case of 6H-BP which seems to be a very potent oxy-PAH. The oxy-PAHs and PAHs interact and thereby increase the effect of single compound or as a mixture treatment for 1, 3, 7 and 14 days. Body length and yolk (energy) consumption were measured and the hearts collected and pooled at the end of every exposure period. Using transcriptomics, proteomics and metabolomics, cardiotoxicity was investigated at molecular level. Our results show that fry exposed to retene and the mixture treatments, in relation to control, became shorter and in retene’s case, had used more yolk by day 14. Retene exposure affected growth and energy consumption by day 7. Microarray analysis showed that the different treatments caused very different alterations in the transcriptome, both in terms of the number of changed genetic expressions and when in time. The only gene (up-regulated at all sampling times and treatments was cypl/a. In addition, ceb and ceb and tfb-like-domains expression were found similarly changed across all treatments but not at all sampling occasions. Using over-representation analysis revealed several biological processes affected, such as blood vessels and heart development following mixture treatment. Transcriptomic analysis is underway but protein expressions are suspected to show a low transcript to protein correlation (based upon literature). Heart tissue metabolomic analysis revealed that across all treatments only two out of 33 metabolites were found in common by day 14. Using integrative quantitative methods, our study discovered several pathways affected by PAH exposure, together with phenotypical alterations, highlighting the unique MoA of different PAHs and as a mixture.

MO237 Assessment of the developmental cardiotoxicity of individual PAHs using integrated OMICS approach C. Rizcar, A. N. Ericksson, University of Jyväskyla / Department of Biological and Environmental Science; A. Krasnov, NOFIMA; J. Lihavainen, University of Helsinki; A. Ronkka, S. Sarai, T. Suomi, A. Laiho, L. Elo, University of Turku and Åbo Akademi University; E. Vehniäinen, University of Jyväskyla / Department of Biological and Environmental Science

Worldwide, environmental levels of polycyclic aromatic hydrocarbons (PAHs) have increased over the last century, mainly due to anthropogenic release from incomplete combustion of organic material and oil spills. These compounds are present as a complex mixture in the environment and are known to cause developmental abnormalities, cardiotoxicity, immunosuppression, tumors and alterations in the expression of genes in vivo. PAH toxicity has been studied for over 100 years and it is currently known that different PAHs have different modes of action (MoA). PAHs like retene and pyrene are alylhydrocarbon receptor agonists that up-regulate CYP1a expression and thereby induce their own metabolism, while other PAHs like fluorene directly inhibit CYP1a activity. In this study, we exposed newly hatched rainbow trout fry (Oncorhynchus mykiss) semi-statically to retene and fluoranthene, the either as single compound or as a mixture treatment for 1, 3, 7 and 14 days. Body length and yolk (energy) consumption were measured and the hearts collected and pooled at the end of every exposure period. Using transcriptomics, proteomics and metabolomics, cardiotoxicity was investigated at molecular level. Our results show that fry exposed to retene and the mixture treatments, in relation to control, became shorter and in retene’s case, had used more yolk by day 14. Retene exposure affected growth and energy consumption by day 7. Microarray analysis showed that the different treatments caused very different alterations in the transcriptome, both in terms of the number of changed genetic expressions and when in time. The only gene (up-regulated at all sampling times and treatments was cypl/a. In addition, ceb and ceb and tfb-like-domains expression were found similarly changed across all treatments but not at all sampling occasions. Using over-representation analysis revealed several biological processes affected, such as blood vessels and heart development following mixture treatment. Transcriptomic analysis is underway but protein expressions are suspected to show a low transcript to protein correlation (based upon literature). Heart tissue metabolomic analysis revealed that across all treatments only two out of 33 metabolites were found in common by day 14. Using integrative quantitative methods, our study discovered several pathways affected by PAH exposure, together with phenotypical alterations, highlighting the unique MoA of different PAHs and as a mixture.
includes detoxification enzymes induction (CYP1A), hemorrhaging, cardiovascular defects, pericardial and yolk sac edemas, craniofacial deformities or growth attenuation. The cardiovascular tissue is one of the most sensitive to PAHs, and all the aforementioned symptoms are caused by the activation of the aryl hydrocarbon receptor (AhR). However, the mechanisms involved downstream of the AhR activation by PAHs are still unclear. Some weak AhR agonists such as phenols can also produce cardiovascular effects (e.g., arrhythmia) via unknown AhR-independent mechanisms. In this study, we explored to explain the mechanisms of toxicity of individual PAHs in the rainbow trout (Oncorhyncus mykiss) ELS by the use of an integrated OMICS approach, i.e. the combined use of transcriptomics, proteomics and metabolomics. The use of OMICS can lead to evidence of which pathways are altered by PAHs, and thus help choosing candidate genes for specific toxicokinetic pathways of toxicity. Newly hatched rainbow trout larvae were exposed to three different PAHs (retene, pyrene or phenanthrene) at sublethal doses. The heart of each larva was sampled after 1, 3, 7 or 14 days of semi-static exposure, and RNA, proteins and metabolites were extracted. Morphometric parameters such as larval length and yolk sac area were also monitored, but were barely affected by PAHs. Preliminary data from transcriptomics and metabolomics showed different signatures of gene expression alteration as well as different metabolite profiles between treatments, suggesting specific mechanisms of toxicity. Overall, all compounds induced more changes in cardiac gene expression during the very first days of development, with the exception of pyrene which was also very potent after 7 days. Preliminary enrichment analysis (over-representation analysis) revealed that differentially expressed genes were linkable with AhR pathway. Exposure to pyrene P450, cation transport, muscular contraction or steroid hormone biosynthesis in the case of retene. Some of those processes were shared by pyrene. Phenanthrene appeared to alter collagen biosynthesis, as well as the glutamate release cycle, but only at one sampling point and with very few genes involved. Proteomic analyses are underway to further highlight the mechanisms of toxicity. 

MO238 Developmental Toxicity of a Non-steroidal Anti-inflammatory Drug (Acetaminophen), in African Catfish (Clarias gariepinus) embryos. L.1 Exzenanye, University Benin / Animal and Environmental Biology; N.O. Exzenanye, University of Benin, Benin City, Nigeria / Animal and Environmental Biology; I. Tongo, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences, Department of Animal and Environmental Biology,University of Benin, Nigeria; P. Adebayo, University of Benin / Animal and Environmental Biology. The study investigated the developmental toxicity of Acetaminophen, a non-steroidal Anti-inflammatory Drug on the early life stage (0 to 96 hpf) of African Catfish (Clarias gariepinus). The 96 hrs fish embryo acute toxicity (FET) test was carried out according to the modified OECD 236 guidelines. Newly fertilized embryos were exposed to different concentrations (0, 0.5, 1, 5 and 10 µL/L) of the drug in triplicates and observations of embryo development were made at different developmental stages. Morphological, physiological and behavioural symptoms of the embryo were assessed. Embryos exposed to acetaminophen significantly altered the morphological and behavioural properties of the fish. The effects were observed to be dose and time-dependent, as more poisoning symptoms were recorded at higher dose. Exposed embryos were observed to have poorly formed somite’s, coagulated embryos, non-detached tail, altered spontaneous movement and inhibited swimming performance. Observed physiological alterations include cardiac edema, sac yolk edema, pericardial edema, tail malformation and lordosis. The result demonstrated that acetaminophen has the potential to alter the development of the early life stage of the African catfish.

MO239 In vitro approach for the identification of early warning biomarkers, related to exposure to PBDEs, in human and marine systems: oxidative stress, toxicity and cell cycle modulation C. Espinosa, S. Manuguerra, M. Morghese, UniPa / DIStEM; A. Cuesta, M. Esteban, University of Murcia / Fish Inmate Immune System Group, Department of Cell Biology and Histology.; A. Santulli, Consorzio Universitario della Provincia di Trieste / Department of Animal Biology; F. Mattapatha, Università di Pavia / Istituto di Immunologia Molecolare (IBIM); A. Cuttitta, M. Sprovieri, CNR / IAMC; L.I. Ezemonye, Capri Granotola, Mazara del Vallo, Trapani, Italy; C. Messina, UniPa / DIStEM The contaminated Sites of National Interest (SIN) in Italy, are characterized by environmental degradation, determined by the impact of industrial activities during the last decades. The primary objective of the project CISAS “Centro Internazionale di Studi Avanzati su Ambiente, ecosistema e Salute umana” (CUP B62F15001070005) is funded by CIPE- MIUR. 

Human and fish cell lines were exposed to different doses of PBDEs until 72 hours. After these experiments, sub-lethal doses were chosen for long term treatments. Expression of genes related to cell cycle, stress, biotransformation, apoptosis and oxidative stress, were analyzed by enzyme assay, spectrophotofluorimetry, immunoblotting and real time PCR. The preliminary results revealed that fish cell lines are more sensitive to the PBDE than human cells. A condition of oxidative stress was induced by the presence of reactive oxygen species (ROS) and relative modulation of scavenger molecule/ enzymes, seems to be the crucial event which influences the expression of some biochemical markers related to toxicity, inflammation, cell cycle control, angiogenesis, indicating the possible stimulation of pathways responsible for cancer promotion. Acknowledgements: the project CISAS “Centro Internazionale di Studi Avanzati su Ambiente, ecosistema e Salute umana” (CUP B62F15001070005) is funded by CIPE- MIUR.

MO240 In silico estimate of affinity constants for perfluorinated compounds in rainbow trout (Oncorhyncu mykiss) proteins. D. Deiji Esposti, Irstea / UR RIVERLY Laboratoire Ecotoxicologie; A. Vidal, Irstea / UR RIVERLY; R. Casadio, University of Bologna / Depar...
which is vital for energy production and is located in mitochondrial membranes. COX activities from zebrafish (Danio rerio), Corydoras (Corydoras aeneus), earthworms (Eisenia fetida), and the lesser rice weevil (Sitophilus oryzae) were placed to be inhibited by pyrogallol and its related chemicals such as gallic acid, 1,2,4-benzenetriol, pyrocatechol, caffeic acid, quinic acid, and chlorogenic acid. For the inhibition of zebrafish COX, pyrogallol was the strongest chemical among the four, with an IC50 of 0.9 µM. Taken together, benzenetriols including pyrogallol may be caused by unexpected inhibitory effects on the animal COX activity, referring fluctuation of the energy production, and the benzenetriol moiety is essential for the inhibition on the COX activity.

**MO243** Exposure to environmental concentrations of Triclosan induces oxidative stress and genotoxicity on zebrafish (Danio rerio) embryos  
C. Parenti, A. Ghilardi, M. Mandelli, University of Milan; C. Della Torre, State University of Milano / Biosciences; S. Magni, University of Milan / Department of Biosciences; L. Del Giacco, University of Milan; A. Binelli, University of Milan / Department of Biosciences; C. Parenti

Triclosan (TCS, 5-chloro-2-(2,4-dichlorophenoxyl) phenol) is the most common antibacterial agent used in personal care products, including soaps, body lotions, laundry detergents, toothpastes and deodorants. For its properties it is also added to several household items such as food packaging materials, toys and textiles. Since TCS is not completely removed by WasteWater Treatment Plants (WWTPs), it is becoming a potential worldwide pollutant and it is frequently detected in surface waters, with concentrations ranging from ng/L to µg/L. There is evidence that TCS is acutely and chronically toxic to aquatic organisms and it was already demonstrated that this chemical severely affects both zebrafish adult and embryos, causing embryotoxicity, hatching delay and biomarker alterations. Thus, the European Union (EU) has disapproved in 2016 the use of TCS in biocidal products, due to its unacceptable environmental risk. Meanwhile, consumer antiseptic wash products containing TCS can no longer be marketed in the EU. The aim of this study was to investigate the adverse effects of TCS at environmental concentrations on zebrafish embryos up to 120 hours post-fertilization (hpf). It is the first time that environmental levels of this contaminant were taken into account, instead of evaluating the effects of sub-lethal or lethal concentrations. The experimental plan consisted in the exposure to two different environmental concentrations of TCS (0.1 and 1 µg/L) for 5 days following fertilization, under semi-static conditions. A suite of biomarkers was applied to evaluate the potential mechanisms underlying the toxicity of TCS such as the generation of oxidative stress and DNA damage. The activity of antioxidant and detoxifying enzymes, namely catalase (CAT), superoxide dismutase (SOD), glutathione peroxidase (GPx) and glutathione transferase (GST), where measured, while the genetic damage was evaluated as the occurrence of the micronucleated cells (MN test). Results show a significant increase in all biomarkers measured, indicating that this chemical is dangerous for aquatic species also at environmental concentrations.

**MO244** Comparative study of acute toxicity of a Microcystis aeruginosa bloom containing microcystin-LR on common carp Cyprinus carpio and Wistar rat  
Z. Hadjer, R. Bordj, H. Nasri, Laboratory of Biodiversity and Ecosystem Pollution, University of El Tarf, Algeria; N. Bouachia, UNIVERSITY PARIS

Microcystins (MCs) are hepatotoxins produced by several groups of cyanobacteria in water bodies throughout the world. Their mechanism of toxicity consists of a heritable change in basal gene expression. This change in gene expression could lead to a stress and genotoxicity on zebrafish (Danio rerio) embryos. Though second generation zebrafish embryos. Though second generation embryos were then grown to adulthood in clean water. These fish were bred and their embryos were collected and reared in clean water (unexposed second-generation embryos). Breeding success of the first-generation developmentally exposed fish was determined by measuring the number of pairs that spawned, number of eggs spawned, fertilization rate, and survival of unexposed offspring. Gene expression and DNA methylation were also measured in 7dpf offspring. Developmental exposure in the first generation did not affect the survival of embryos and also did not affect breeding success when compared to control, but differed among exposure groups. Some target genes were differentially expressed in the exposed second-generation embryos when compared to control, indicating a heritable change in basal gene expression. This change in gene expression could potentially be due to changes in DNA methylation caused by the developmental exposure in the first-generation. Understanding what changes in DNA methylation mean for fish survival will require further study. Overall, it appears that developmental exposures to toxic chemical contaminants can have various effects on first- and second-generation zebrafish embryos. Though second-generation endpoints are often overlooked, they are important to consider when evaluating the overall risk of oil exposure.
MO248
Linkage of gene expression patterns with in vivo endpoints: gaining deeper insights
A. Zenker, University of Appl. Sc. Northwestern Switzerland / Institute of Environmental Sciences; N. Munz, University of Applied Sciences and Arts Northwestern Switzerland

The herbicide glyphosate and the pharmaceutical lisinopril are among the most popular chemicals that have been detected in many streams at low concentrations. Nevertheless, the ecotoxicological properties, especially of lisinopril, are largely unknown. The objective of the study was to find early detection markers by comparing in vivo effects and gene expression patterns in the fish embryo acute toxicity test (FET) and early-life stage toxicity test (ELS). Per substance 480 individuals of zebrafish were exposed to five different concentrations (lisinopril: 0.03 – 0.5 mg/L; glyphosate: 0.006 – 0.1 mg/L) and analysed for different morphological endpoints such as spontaneous movements, heart rate, hatching success and mortality. Gene expression patterns in this inhibition for fish ability to detoxify xenobiotics remain to be elucidated. Keywords: rainbow trout, cytochromes, EROD, COH Acknowledgement - The study was financially supported by the Ministry of Education, Youth and Sports of the Czech Republic, projects CENAKVA (No. CZ.1.05/2.1.00/01.0024), CENAKVA II (No. LO1205 under the NPU I program), by the Czech Science Foundation (No. 18-15802S) and Swedish University of Agricultural Sciences.

MO249
New insights on cross-species differences in the modulation of human and zebrafish nuclear receptors by single chemicals and environmental mixtures
N. Creusot, Eawag - Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; C. Garoce, INERIS; A. Boualhouth, INSERM / IRCM - U1194; F. Brzon, INERIS / Ecotoxicology Unit; W. Bourguet, CBS CNRS UMR5048 - INSERM U1050; A. Escande, Universite de Montpellier; M. Grimaldi, INSERM / IRCM - U1194; S. Ait-Aissa, INERIS / UMR SEBIO ECOT; P. Balaguer, INSERM / IRCM - U1194

In the context of contamination of aquatic ecosystems by endocrine disrupting xenobiotics and a wide range of endogenous compounds. Skatole is well known mammalian metabolite, however rarely considered as environmental relevant pollutant. In fact, presence of skatole in aquatic environment is common and associated responses, to improve the involvement of unexpected metabolic pathways. This approach is an alternative to the classic targeted methods, as it did not focus on a few metabolic pathways, for which we already know that are affected by the specific stimulant and enables to unravel the involvement of unexpected metabolic pathways.

MO250
Combining acute toxicity, toxicokinetics and metabolomics approaches to assess the effects of triclosan in zebrafish embryos
D.E. Damalg, National and Kapodistrian University of Athens / Chemistry; M. Agalou, Biomedical Research Foundation Academy of Athens / Developmental Biology; D. Beis, Biomedical Research Foundation Academy of Athens / Developmental Biology; M. Lamoree, VU University, Department Environment & Health / Department Environment & Health; P. Leonards, VU University, Institute for Environmental Studies / Department of Environment and Health; N.S. Thomarios, National and Kapodistrian University of Athens / Department of Chemistry

Triclosan (TCS) constitutes a common household product, given its antimicrobial activity, and has been widely used over the past decades. It enters the sewer system and can be transported to wastewater treatment plants (WWTP), sewaters and rivers, resulting in the contamination of the aquatic ecosystem. Consequently, it is urgently to evaluate its potentially toxic effects to aquatic organisms. The triclosan has emerged as a powerful model organism to study various aspects of developmental and cell biology, while it provides an alternative model for toxicological studies. The objectives of this study were to assess to what extent TCS induce toxicity in zebrafish embryos. In addition, we evaluated the uptake and biotransformation of TCS by zebrafish and examined whether the biotransformation data could be used complementary to the concentration of the parent TCS to interpret the induced toxicity. The main goal was to establish a wide-scope targeted metabolomics screening workflow to investigate the induced toxicity in a biochemical perspective and associate the observed toxicity/phenotype with changes in molecular level. Overall, the aim was to highlight a hightroughput test to evaluate in vitro the incorporation of different determinants of toxicity, for a comprehensive toxicity assessment of environmental stressors in aquatic organisms. The zebrafish embryo toxicity assay was used to calculate the LC50 value of TCS as well as to perform the morphological phenotyping. In addition, a liver specific fluorescent transgenic line (Tg:ELFABP:GFP) was used, to evaluate TCS liver toxicity potential. Concerning the toxicokinetics and the metabolomics experiment, 96 hpf zebrafish embryos were used. Samples were collected at 5 different time intervals, from 30 up to 24 hours post exposure (hpe). Detection and identification of tentative TCS-bio-TPs was performed through in-house developed suspect and non-target screening workflows. Bio-TPs arising from both oxidative and conjugative metabolic reactions were identified. Regarding the metabolomics part of the study, a database of over 600 endogenous metabolites (carboxylic acids, amines, nucleotides, etc.) was established prior to a broad-scale untargeted metabolomics analysis. Prostaglandin F2-like derivatives have emerged as a reliable biomarker for oxidative stress in mammals and fish namely the F2 isoPs from fish skin. This approach is an alternative to the classic targeted methods, as it did not focus on a few metabolic pathways, for which we already know that are affected by the specific stimulant and enables to unravel the involvement of unexpected metabolic pathways.
Persistent organic pollutants alter the expression patterns of epigenetic factors in the Zebrafish Liver (ZF-L) Cell line. M. Blanc, Orebro University / MTM Research centre; N. Scherbak, Orebro University / School of Science and Technology, Life Science Centre; S. Keiter, Orebro University / MTM Research centre

Several studies demonstrated that exposure to persistent organic pollutants can induce epigenetic modifications in human and other vertebrates, including fish. It is of particular interest since epigenetic changes were reported in zebrafish with increasing incidence such as cancer. Besides, epigenetic disruption was suggested to be one mechanism responsible for multigenerational effects of chemical exposure. Epigenetic pathways in zebrafish are similar to mammalian; therefore, it was proposed as an alternative model for epigenetic research. The focus of the present study was set on the investigation of epigenetic effects in the Zebrafish Liver (ZF-L) cell line after 48 h of exposure to 8 selected compounds. The cells were exposed to the LC_{10} values of pesticides (methoxychlor (MXC), permethrin (PER)), plastic additives (bisphenol A (BPA) and S (BPS)), perfluorinated compounds (perfluorooctane sulfonic acid (PFOS), perfluorobutane sulfonic acid (PFBS)), a whitening agent, 7-diethylamino-4-methylcoumarin (DEMOC); and to the metal selenium (Se), the primary form of Se in the diet. Selenium (Se) is a naturally occurring trace element that is recognized as a contaminant of concern in Canadian aquatic ecosystems because of its high potential to bioaccumulate and persist even after its source has been removed. All animal classes are susceptible to the effects of Se due to the narrow range between dietary essentiality and toxicity; however, oviparous vertebrates, especially fish, are at a particular risk for the toxic effects of Se. A comprehensive study was performed in rainbow trout to develop and validate an embryo injection approach to model maternal transfer of selenomethionine (SeM), the primary form of Se in the diet. This model could then be applied to any egg-laying species of interest and could provide insight regarding differences in species sensitivity to Se toxicity during early life stage development. Initial characterization of dietary SeM and its effect on the F1 generation was characteristic of a short-term physiological modulated response in wild-type fish. Freshwater systems, the fathead minnow (Pimephales promelas), 20 breeding groups (3 females:2 males) were fed a SeM-spiked diet of either 0, 3, 9, or 27 mg Se/kg bloodworms dry weight (dw) and bred for 28 days. Embryo Se concentrations increased immediately upon onset of exposure and Se concentrations reached approximately a 1:1 ratio in food:embryo after 28 days on the diet. There was a significant difference in mean embryo Se concentrations from the control (1.18 mg/kg embryo dw) in the medium (8.75 mg/kg embryo dw) and high (29.58 mg/kg embryo dw) treatment groups. Embryos collected on days 26, 27 and 28 were reared to swim-up and assessed for morphological abnormalities. Preliminary assessment revealed an increasing, although not significant, trend in the frequency of deformities between the control and high treatment groups (p=0.057); however, a more robust analysis is on-going. Average Se embryo concentrations from this study will serve as the basis for subsequent embryo injection studies in fathead minnow. Developmental endpoints from both studies (e.g. mortality, frequency of deformities, types of deformities, severity of deformities) will be compared to determine if the embryo injection model is an appropriate risk for shortening the maternal transfer of Se. The embryo injection model could also support mechanistic and omic-based research in long-lived species of concern, such as white sturgeon, or in recreationally fished species such as we. The present results showed that ZF-L cells were responsive to epigenetic disruption. They brought further evidence on the potential of chemicals to interfere with both DNA methylation and chromatin accessibility. However, further studies are required to investigate to what extent the observed changes are reflected in DNA methylation and chromatin accessibility themselves, together with their correlation in in vivo models.
Zebrafish responses to the fourth-generation pros tegren drospironere exposures
C. Quintanenre, Department of Biology & CESAM - University of Aveiro; A.M. Soares, University of Aveiro / department of Biology & CESAM; M. Monteiro, Aveiro University / Biology
Synthetic proestogens (PGs) represent an important class of active ingredients of hormonally active pollutants. These substances have been shown to occur in the environment and to exert effects on fish and other species, including humans. They are known to interfere with the function of endocrine systems and to disrupt the normal developmental processes of fish, leading to reproductive and developmental abnormalities. The presence of PGs in the environment has led to increased concern about their potential impact on aquatic ecosystems and human health.

MO258
Fish caging experiment as a tool for detection of in situ effects of untreated wastewaters: General stress and endocrine disruption
D. Papi, University of Novi Sad Faculty of Sciences - Biology and Ecology; B. Milcic, Petnica Science Center/Faculty of Sciences, University of Novi Sad / Department of Biology and Ecology; S. Sipos, Faculty of Sciences University of Novi Sad / Biology and Ecology; V. Knezevic, Faculty of Sciences / Department of Biology and Ecology Laboratory of Ecotoxicology LECOTOX; S. Kaisarevic, Faculty of Sciences University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology (LECOTOX); University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology (LECOTOX)
A direct discharge of untreated municipal wastewaters from the city of Novi Sad into the River Danube made a location a focal pollutant hotspot within the framework of FP 7 funded Solutions project. A study conducted previously at this site provided detailed chemical characterization of water samples. Relatively high concentrations of many chemicals were identified as of DRP's potency was confirmed with a battery of in vitro assays. As a follow-up, a fish caging experiment was conducted with the aim to check if the biological effects observed in vitro can be seen in situ, through a battery of biomarkers in liver and brain of caged fish. Ten specimens of common carp (Cyprinus carpio (L.), Cyprinidae), both male and female, were exposed for nine days at three sites in the River Danube: upstream (reference site), cca. 250 m and 7 km downstream of the major discharge point of the untreated sewage into the River Danube. Certain detected chemicals are recognized causative agents of endocrine disruption and stress in general with a potential to lead to adverse physiological effects. Therefore, stress marker enzyme assays (catalse, carboxylesterase and glutathione S-transferase) were performed, and the expression of stress, endocrine disruption, immune response and autophagy related genes was analysed using qRT-PCR. Selected genes included cytochrome oxidase subunit 1 (cox1), metallothionein (mt), heat shock protein 70 (hsp70) as general stress related genes; estrogen receptor a (era), estrogen receptor b (erf), androgen receptor (ar), cortisol receptor (cr) and vitellogenin (vgt) as endocrine disruption related genes; interleukin1β (il1b) and tumor necrosis factor (tnf) as immune response related genes, while light chain 3 (lc3ii) and dynein (dyn) were selected as autophagy related genes. Expression activities were higher in specimens caged at downstream locality, while catalse was lower at sewage discharge point. General stress and endocrine disruption representative genes at downstream site follow the trend of overexpression vs control (reference site), while the vgt was down-regulated at discharge point. Expression of vgt was strongly up-regulated at downstream site, while no significant difference was noted among expressions of other immune response and autophagy related genes. The results indicate induction of adaptive stress responses and endocrine disruption and are in line with the results observed in vitro.

MO259
Gene transcription ontology of hypothyram-pituitary-thyroid axis development in early-life stage fathead minnow and zebrafish
The hypothalamic-pituitary-thyroid (HPT) axis is known to play a crucial role in the development of teleost fish. However, knowledge of endogenous transcription profiles of thyroid-related genes in developing teleosts remains fragmented. We selected two model teleost species, the fathead minnow (Pimephales promelas) and the zebrafish (Danio rerio) to describe the gene transcription ontology of the HPT-axis. Control embryos were sampled at several time points between fertilization and hatching, and larvae were sampled approximately every other day until 33 days post-fertilization. Total RNA was extracted from pooled, whole fish, and thyroid-related mRNA expression was evaluated using quantitative polymerase chain reaction (qPCR). Gene ontology (GO) terms and pathway enrichment were assessed by alterations on lipid peroxidation (LPO). Exposure to DRP did not affect hatching rate, growth and development of zebrafish embryos, however, there was a decrease on heart rate with increasing concentrations of DRP. Several endpoints, our study showed that DRP might exert adverse effects at both physiological and biochemical levels at concentrations similar to those found in environment for PGs. Furthermore, our results highlight the need to assess PGs toxicity at different levels of biological organization.

MO260
Skin vitellogenin and estrogen receptor as sensitive biomarkers of estrogenicity in a sub-Antarctic fish.
The fast expansion of socio-economic activities on coastal areas has increased the presence of anthropogenic pollutants from industrial and domestic sources over the last decades. Recent studies have reported the presence of many persistent organic pollutants in water, sediments and in vertebrates from Antarctic areas; however, information about their potential impact on fish physiology is still scarce. The southernmost city of the world, Ushuaia (Tierra del Fuego, Argentina), and its bays are not the exception to the decline of the environmental quality. Notothenioid fish are the dominant group of fish species at sub-Antarctic Antarctic regions, playing a key role in these ecosystems. The black southern cod, Patagonotothen tellusissum is widespread in the Beagle Channel, lives in the intertidal zone, and possess paternal care. The aim of the present work is to validate vitellogenin (vgt) and estrogen receptor (ren) as biomarkers of estrogenicity in skin samples of this species in order to provide a helpful tool to develop and perform studies in fields like chronic exposure of contaminants and environmental risk in places where contamination already exists. Male fish were injected with 17β-estradiol (i.p, single dose of 10 mg/g or vehicle). Vitellogenic females were used as positive controls. Samples of skin and liver were obtained to assess vgt and ERα mRNA expression and physiological responses were studied through different endpoints: histological analysis, vgt detection in plasma samples, and sex steroid levels (estradiol (E2) and testosterone (T)). Seventy-two hours post-injection histological analysis showed normal unrestricted testis and intense cytoplasmic basophilia in hepatocytes. No vgt was detected in plasma samples of control males or before E2 injection; however, three days after treatment, males showed plasma
these concentrations affected survival or growth, resulting in a sub-chronic NOAEC and LOAEC of 4.5 and 10 µg/L chlorpyrifos, respectively, in fathead minnows. Samples are currently being further analyzed for molecular and physiological endpoints to gain insight into critical toxicity pathways. This study is part of the EcoToxChip project (@ecotoxchip).

MO264 Evaluation of the deleterious effect of 2 pesticides on juveniles of the zebrafish Danio rerio
G. Geraldo Morales, Universidad Autonoma Metropolitana Iztapalapa / Departamento de Hidrobiologia; A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiologia
In this study an evaluation of the toxic effect of 2 pesticides: Dichlorvos which is an organophosphorus insecticide, used for the control of ectoparasites in fish, and insecticide Imipronitrin belonging to the group of pyrethroids, used as a main component in products for domestic use, was carried out. Because the previous studies with these products are scarce, the objective of this work was to evaluate its toxicity and its effects in 3 biomarkers: peroxidation of liver macrophores (liperoxidation), the activity of the enzyme acetycholinesterase (AchE) and the production of macromolecules (proteins, lipids and carbohydrates). Initially a test (96 hrs) was made, where zebrafish juveniles were exposed to 5 concentrations of pesticides (10, 1, 0.1, 0.01, 0.001, 0.0001 mg L\(^{-1}\)) to determine the 50 lethal concentration (LC\(_{50}\)). Subsequently a bioassay with a duration of 15 days it was carried out where zebrafish juveniles were exposed to 2 sublethal concentrations (LC\(_{10}\) and LC\(_{50}\)), the resorption of oocytes show the highest and most toxic (LC\(_{50}\) and LC\(_{10}\) < 1.67 to 87.6 mg/L) than Dichlorvos (LC\(_{50}\) = 5.3 mg L\(^{-1}\)). In the sublethal bioassays it was observed that the toxicity of these xenobiotics increased with the time of exposure. The degree of liperoxidation in the imipronitrin tested varied from 64.7 to 147.5 nm TBars mg\(^{-1}\) and was higher than that observed in the bioassays with Dichlorvos (22.6 to 93.8 nm TBars mg\(^{-1}\)). In the fish exposed to Dichlorvos a decrease of 43% to 86% in the activity of the AchE enzyme was observed and from 14% to 64% in the juveniles exposed to imipronitrin. The juveniles of zebrafish that showed a decrease in the activity of the AchE greater than 35% had changes in their swimming behavior and in their feeding. The energy content of the fish exposed to pesticides decreased by 64% in the Imipronitrin tests and 81% in the Dichlorvos bioassays. The insecticides Dichlorvos and Imipronitrin are little persistent in the environment, their half-life is 5 to 8 days, but the results of this study indicate that their effects on organisms are probably irreversible.
MO267 Acute effects of the ayahuasca infusion (Banisteriopsis caapi and Psychotria viridis) on zebrafish and rodent models
T.S. Andrade, Universidade de Brasília / Laboratory of Genetics and Toxicology; W. Melo Junior, University of Brasilia; R. Oliveira, State University of Campinas / SCHOOL. OF TECHNOLOGY - UNICAMP; A.D. ANDRADE, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; M.L. da Silva, University of Brasilia / genetic toxicology; J.A. Morais, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; C. Koppe Grisolia, University of Brasilia / Department of Genetics and Morphology; L. Domingues, University of Aveiro / CESAM Department of Biology; E.D. Caldas, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; A. Pic-Taylor, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; A. Barros, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; H. Lee, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; C. Di Paolo, RWTH Aachen University / Research RWTH Aachen University; M. Gundlach, RWTH Aachen University / Institute for Environmentalgis, Institute for Environmental Analysis (ESA); M. Spehr, B. Kampa, RWTH Aachen University; H. Legradi, Institute for Environmental Analysis (ESA); C. Di Paolo, RWTH Aachen University / Environmental Science and Technology / Environmental Engineering
Abstract
Results
Conclusions
MO268 Chronic exposure to fluoxetine affects growth, feeding, swimming behavior and tissue organization of zebrafish.
N. de Farias, University of Brasilia / Departamento de Genética e Morfologia; R. Oliveira, State University of Campinas / Department of Genetics and Morphology; T.S. Andrade, Universidade de Brasilia / Laboratory of Genetics and Toxicology; J.M. Pinto, University of Brasilia / Departamento de Genética e Morfologia Instituto de Biologia; C.K. Grisolia, University of Brasilia UnB / Department of Genetics and Morphology
Fluoxetine (FLX) is among the top 100 drugs prescribed annually worldwide. This selective serotonin reuptake inhibitor is highly detected in aquatic ecosystems and has the potential to modulate levels of serotonin of non-target organisms. The present study aims to evaluate the effects of chronic exposure to FLX on fish. Zebrafish juvenile were exposed to FLX during 30 days following the OECD protocol (no. 215). The assays were performed in triplicate with six treatments of FLX: 0; 0.01; 0.1; 1; 10 and 100 µg/L. A total of 60 fish per treatment (20 per replicate) were used. Growth and feeding behaviour were analysed at the end of the test. Histological analyses of liver followed standard H&E routine. Video recordings (10 min) were analysed for swimming behaviour by measuring the time spent by each fish in each of the layers of the aquarium (bottom: 0–5 cm, middle: 6–10 cm and upper: 11–15 cm). Our results showed decrease in growth rate and erratic feeding behaviour at 100 µg/L. Also, in concentrations as low as 0.1 µg/L were observed histological alterations in the liver microstructure such as decrease of the glycogen and progressive loss of hepatic architecture. The pattern of swimming behaviour of fish changes significantly, fish spend more time at the upper part of the aquarium in concentration above 10 µg/L. Altogether, the present study demonstrated that chronic exposure of zebrafish to FLX can affect multiple endpoint such as growth tissue organization, feeding and swimming behaviour. These results emphasize the relevance of an integrated approach in the ecotoxicological assessment of psychiatric drugs.
MO269 Mitochondrial Disorders of Zebrafish Embryos Exposed to Individual Organochlorine Pesticides and Their Mixtures
H. Legradi, Seoul National University of Science and Technology / Environmental toxicology and health; S. Lee, Seoul National University of Science and Technology / Environmental engineering; K. Kim, Seoul National University of Science and Technology / Environmental Engineering
Organochlorine pesticides (OCPs), prohibited compounds in the 1970s, are still being detected in human and environmental samples. Mitochondrial dysfunction caused by chemical exposure has attracted great attention on toxicological studies. We evaluated mitochondrial dysfunction in dechorinated zebrafish embryos exposed to individual 5 OCPs (i.e., p,p-DDT, Chlordane (mixture), Heptachlor, Hexachlorobenzene (HCB), and beta-hexachlorocyclohexane (b-HCH)), and their mixtures from 4 to 120 hpf (hours post-fertilization). We measured oxygen consumption rate (OCR) at the embryonic sublethal concentrations of 0.05, 0.1, and 0.5 mg/L by using Seahorse XFe Extracellular Flux Analyzer at 24 hpf. The OCR results are compared with the activity of mitochondrial complex I–IV after isolating mitochondria from embryos at 48 hpf. In addition, we analyzed mRNA expression of transcription factors (i.e., PGC-alpha, Acox1, SDHA, MCAD, and CBP), associated with mitochondrial metabolism, at 120 hpf. This comprehensive series of tests could suggest the relevance of the embryonic zebrafish model on the methodology and a set of research scheme to determine mitochondrial disorders in the exposure of individual OCPs and their mixtures.
MO270 The NeuroBox Project
H. Verhees, Vrije Universiteit Amsterdam; A. Haigs, Institute for Environmental Research RWTH Aachen University; M. Gundlach, RWTH Aachen University / Department of Ecosystem Analysis ESA; C. Di Paolo, RWTH Aachen University / Ecosystem Analysis (ESA); M. Spehr, B. Kampa, RWTH Aachen University / Ecosystem Analysis (ESA); H. Legradi, Institute for Environmental Analysis (ESA); C. Di Paolo, RWTH Aachen University / Institute for Environmental Research RWTH Aachen University
The societal impact of neurological disorders like Alzheimer’s disease or neuropsychiatric deficits like schizophrenia is tremendous. Although research initiatives, the effects, e.g. severe mental and physical problems, are often devastating. There is mostly no cure available and even treatments to reduce or stop the progression of the diseases are limited. The number of people diagnosed with neurological disorders is increasing. This increase cannot be explained by improved diagnostics and increased age. Exposure to neurotoxic chemicals is suspected to play a role in the development and progression of these diseases. It has been estimated that alone in Europe, exposure to solely endocrine disrupters that lead to neurological disorders costs society €150 billion per year. This does not include costs due to pharmaceuticals and neurotoxic effects. In combination with mouse models and clinical researchers we will improve our subprojects. In our subproject, we use zebrafish embryos to identify neurotoxic compounds and neurotoxic effects. In our subproject, we use zebrafish embryos to identify neurotoxic compounds and neurotoxic effects. In our subproject, we use zebrafish embryos to identify neurotoxic compounds and neurotoxic effects. In our subproject, we use zebrafish embryos to identify neurotoxic compounds and neurotoxic effects. In our subproject, we use zebrafish embryos to identify neurotoxic compounds and neurotoxic effects. In our subproject, we use zebrafish embryos to identify neurotoxic compounds and neurotoxic effects. In our subproject, we use zebrafish embryos to identify neurotoxic compounds and neurotoxic effects. In our subproject, we use zebrafish embryos to identify neurotoxic compounds and neurotoxic effects. In our subprojects, the work is split over six subprojects. In our sub-project, we use zebrafish embryos to identify neurotoxic mode of actions of commonly found water contaminants. Based on our findings novel screening assays will be developed to easily screen water samples for neurotoxic effects. In combination with mouse models and clinical researchers we will also link our results to mammalian neurological diseases like ADHD and autism and neurodegeneration studies, to identify potential exposure-disease relationships. Furthermore, we will study the link between endocrine disrupting compounds and neurotoxic effects. We could see behavioral as well as metabolomics and transcriptomic changes after exposure to compounds. These
changes were observed ad concentrations below any phenotypic changes could be observed. Our results so far show that assessing neurotoxicity is complex and a tiered approach covering behavioral tests in combination with OMICS techniques seem to be a cost and time efficient way.

MO271 Understanding the correlation between behavioural inter-individual variability and physiology/morphology in zebrafish larvae
K.T. Kiria, C.M. von Berg, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology

Background: Zebrafish are widely used in biomedical research as they offer several features such as the fully sequenced genome, availability of a wide range of mutants generated of various types and organs, and the possibility to compare normal and conserved vertebrate drug targets to a great extent. Early stages of zebrafish are called as non-protected life stages and are therefore used for testing chemicals for their toxicity as an alternative to conventional animal testing. Moreover, zebrafish larvae are amenable to test neurotoxicity and behavioural effects of chemicals as their small body size allows tracking a large number of individuals with full control over the environment. Aim: The aim of the project is to investigate behavioural inter- and intra-individual variability in zebrafish larvae as a basis to better estimate effects of chemicals on behavioural responses. Analysis of inter-individual differences might offer new insights into mechanisms of toxicity considering that every individual’s response to a chemical differs based on their genetic make-up.

Hypothesis: We are testing whether inter-individual variability is constant over time and whether levels of locomotor activity correlate with physiological and morphological properties of the larvae. Methods: At first, spontaneous locomotor activity is measured for 40 min in continuous light at different timings of the day from 5-7 days post fertilization. Heart rate, body size and other physiological properties of the same individuals are analysed at different time points. Results: From the preliminary results of the locomotor activity analysis, we could assign the larvae to three categories based on their activity levels compared to the average activity: highly active, less active and the individuals close to the average activity, which are also the ones less variable over time. To attribute this variability in the individual’s activity to its physiology and phenotype, the analysis of heart rate, length and blood flow are on-going. Outlook: The variability of each individual will be taken into account to better evaluate effects of the chemicals on behavioural responses. Inter-individual differences will be explored as a source of information on mechanisms of toxicity of chemicals with unknown targets and mode of action.

Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (P)

MO272 Effect of iodinated X-ray contrast media in the formation of disinfection byproducts during chlorination and chloramination of water
C. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; M. Armstrong, University of North Carolina at Chapel Hill/ Department of Environmental Science and Engineering; H.K. Libatore, K. Lamann, S. Kimura, A. Cuthbertson, S.D. Richardson, University of South Carolina; T. McDonald, Y.M. Sey, U.S. Environmental Protection Agency / National Health and Environmental Effects Research Laboratory; S. Duirk, University of Akron; J. Simmons, U.S. Environmental Protection Agency / National Health and Environmental Effects Research Laboratory

Iodinated X-ray contrast media (ICMs), used in medical imaging, are poorly metabolized by humans and enter wastewater. As they are incompletely removed during wastewater treatment, ICMs are released to the aquatic environment and have been detected in drinking water sources. ICMs have been identified as iodine sources that may enhance the formation of iodine-containing disinfection byproducts (DBPs) during drinking water disinfection. This work investigated the effect of different ICMs, iopamidol (IPAM), iopromide (IPI), diatrizoate (DTPZ) and ioxhol (IXH), in the formation of different classes of DBPs during source water disinfection by either free chlorination or chloramination. To do this, we performed large-volume (~120 L each), laboratory-controlled, headspace-free disinfection reactions with 5 μM ICM and 100 μM as Cl₂ disinfectant concentrations. The resulting DBP mixtures were chemically characterized for 21 DBPs. The presence of ICMs, particularly in chlorinated water containing ICMs, enhanced formation of dichloroacetic acid, bromoacetic acid and poly(vinylidenefluoride-co-hexafluoropropylene) as the polymer and Aliguet 336 as the extractant, for the online preconcentration and separation of As(V) in a PIM cell. The sample solution is propelled for a predetermined period of time through the PIM cell where a PIM separates the sample stream and an acceptor stream which is stopped during the sample passage through the PIM cell. The PIM contains a preconcentration of As(V) in the static acceptor solution located in the acceptor channel of the cell. The analytical procedure involves a 15 min stop-flow time and sample solution flow rate of 2.5 ml min⁻¹. After the stop-flow time the acceptor stream is re-started and As(V) is reduced to arsenite (As(III)) by merging the acceptor stream with a reagent stream containing 4 M HCl, 1% NaBH₄ and 0.5 % ascorbic acid. This is followed by arsine generation using another reagent stream incorporating 0.5 % NaBH₄ and 0.05 M NaOH. The generated arsine is transported across the hydrophobic membrane of a gas diffusion cell into a solution containing 0.02 mM KMnO₄ and 0.05 M NaOH where it is oxidised thus producing a decrease in the KMnO₄ absorbance, monitored continuously at 528 nm. Under optimal conditions the FA system achieved a detection limit of 1 pg L⁻¹ with a sampling rate of 2.5 h⁻¹ and a repeatability, expressed as RSD of 1.8% (n=5, 25 μL⁻¹) and 2.8% (n=5, 50 μL⁻¹). The FA method has been successfully applied to the determination of As(V) in tap water in the μg L⁻¹ concentration range.

MO274 Balancing environmental quality standards and infrastructure upgrading costs for the reduction of microcontaminants loads in rivers
V.P. Jimeno-Media, Catalan Institute for Water Research (ICRA); J. SEVERNYS, AQUAFIN; J. Comas, L. Coroninas, Catalan Institute for Water Research ICRA Investments for upgrading wastewater treatment plants (WWTPs) with tertiary treatment to reduce microcontaminants loads in surface waters at a catchment scale can be daunting. Our hypothesis was that these investments seriously change upon selection of the Environmental Quality Standards (EQS) for unregulated microcontaminants, and hence there is a trade-off between EQS selection and investment which needs to be considered in decision-making. We used a customized Microcontaminant Fate and Transport Model coupled to an optimization algorithm to validate this hypothesis. We used the Llobregat river basin as a case study and diclofenac as the unregulated microcontaminant. The algorithmized the decision-making of WWTPs in this catchment requiring an upgrade to optimize the EQS exceedance of diclofenac in drinking water at a minimal cost. We simulated 40 scenarios representing a combination of 4 potential EQS which are currently being discussed in the European Union (10, 30, 50 and 100 ng/L), 5 levels of uncertainty bounds in the predictions of river concentrations and 2 hydrological scenarios (average flows and low flows). The results showed that the optimization of WWTPs in the Llobregat river basin was 8 M€/year (upgrading 8 WWTPs out of the existing 56 for fulfilling an EQS of 30 ng/L in the entire catchment). Such an investment seriously changed upon selection of EQS. The cost varied from 6 M€/year (upgrading 3 WWTPs for fulfilling an EQS of 100 ng/L) to 13 M€/year (upgrading 18 WWTPs, for fulfilling an EQS of 10 ng/L). We observed that the selection of catchment hydrological conditions during the upgrading analysis also plays a key role. The cost of the upgrades when considering low surface water flows (minimum environmental flows that ensure compatibilization of environmental needs and human water consumption) was 50% higher than the cost obtained with average flows (average
hydrological conditions in the Llobregat). Finally, we demonstrated that the reduction of uncertainty in the modelling process (through R&D activities) provides transparency in the decision-making process.

MO275 Calibration of passive samplers for the monitoring of drugs in French Caribbean Basin.
N. Tapié, Univ. Bordeaux, CNRS, EPOC UMR 5805 / EPOC UMR 5805; D. Devault, Univ. Paris Sud / ESE UMR 8079; S. Karolak, Univ. Paris Sud, CNRS, AgroParisTech / ESE UMR 8079; Y. Levi, Univ. Paris Sud / ESE UMR 8079; H. Budzinski, University of Bordeaux

Drugs are more and more consumed worldwide (ONUDC, 2017). The French Caribbean is a hub of world cocaine trafficking and an important place of consumption of cocaine in the form of crack. The local population is particularly affected by this scourge. The consumption of illicit drugs induces the excretion of parent compounds or metabolites (markers of drugs uses) in waste water, and in the end their release into the aquatic environment. So, one of the ways to evaluate the local use of illicit drugs is to track drug residues in waste water treatment plants (WWTP). The present study that takes place in the SENEUR Project and explores the use of passive sampling techniques to monitor illicit drugs in WWTP. Polar Organic Chemical Integrative Samplers (POCIS) were exposed in situ in a Waste Water Treatment Plant in Martinique (French Caribbean) during ten days. First an analytical development by ESI-LC/MS/MS was done in order to be able to analyze 17 compound as markers of drug uses (cocaïne, heroin, amphetamine, cannabis, their main metabolites and some substituents products such as norcotinine) in effluent and in POCIS (LOQ from 0.01 to 0.1 pg/g). Secondly triplicates of POCIS were exposed in WWTP for calibration during 10 days. POCIS were collected at different times, T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11. Water samples were also daily collected. The first result of the calibration show a good capacity of the POCIS to sample cocaine markers (cocaïne, benzoylecgonine, cocaethylene, benzoylecgonine, metabolite markers (Norcotinine, MPPP, Carboxy-THC) and morphine over short exposure time (3 to 5 days). The calculated sampling rate (Rs) vary from 0.004 for benzoylecgonine to 0.2 L1/J for cocaine.

MO276 Passive sampling in surface water as an immobilization-based approach to extrapolate waste-water-related pressures and potential EQS exceedence in Luxembourg.
T. Galle, Luxembourg Institute of Science and Technology; D. Pitois, M. Bayerle, Luxembourg Institute of Science and Technology LIST

The pressure on surface waters that is exerted by emerging pollutants depends on the loads arriving at treatment plants and the treatment efficiency. Both can be variable depending on the compound, the contributors of the sewer network as well as the design and operation of the treatment plant. Several emerging compounds have mixed uses and can therefore stem from domestic as well as from industrial sources. Regulators have an interest in knowing immission situations that will probably lead to EQS exceedences without needing to monitor emerging substances in the whole metropolis. Thus, the use of passive sampling is an opportunity to monitor the immission situation in 15 surface waters under low-flow conditions and different sanitary pressures in Luxembourg. We define sanitary pressure as the number of population equivalents divided by the surface of the catchment for a monitoring point. For that purpose, a catchment delineation is performed for each measurement point and the PE/ha on the contributing sanitary pressure is determined using the natural flow. Since WWTPs are relatively constant sources sampling rates of passive samplers can easily be calibrated with grab samples over all monitoring locations. The data evaluation uses the conservative behaviour of carbamazepine as a tracer for (treated) wastewater input. Carbamazepine concentrations proved to be correlated to the sanitary pressure (PE/ha) in a catchment. The plotting of other compound concentrations against carbamazepine holds useful information: it shows the variability of the WWTP influents as well as elimination capacities in the catchment. According to these hypotheses recalcitrant pharmaceuticals showed very strong and narrow linear correlations with carbamazepine while immediately degradable compounds displayed higher variability. Complete outliers make it easy to detect industrial sources as was the case for triazoles for instance. Finally the data set made it possible to extrapolate expected concentrations of emerging compounds for different sanitary pressure levels and by integrating EQS values, to define a threshold of 2.5 PE/ha above which EQS exceedance for diclofenac and clarithromycin is expected. This makes it easy to design a map of the river network with segments at risk with basic population equivalent information.

MO277 Determination of Perchlorate by U.S. EPA Method 332.0 Using a Compact Ion Chromatography System Coupled with Mass Spectrometry (IC-MS)
B. Huang, Thermo Fisher Scientific / marketing; T. Cross, Thermo Fisher Scientific; J. Rohrer, Thermo Fisher Scientific / Chromatography and mass spectrometry division

Perchlorate has been used as an oxidizer in rockets, munitions, and fireworks since it was first synthesized in 1864. Perchlorate is regulated under the Safe Drinking Water Act (2011). Massachusetts and California have established standards for drinking water of 2 μg/L and 6 μg/L, respectively. Determination of perchlorate in environmental samples has also gained the attention of the International Standards Organization (ISO). U.S. EPA Method 332.0 — Ion Chromatography with Suppressed Conductivity and ElectroSpray Ionization/Mass Spectrometry is one of the most sensitive and robust characterization methods available for perchlorate determination (MS) of water samples. The detection limits in high-ionic-strength matrices like conductivity detection alone. These low detection limits are achieved without sample preparation. Our study updates the IC-MS method published in U.S. EPA Method 332.0 for determination of perchlorate in environmental waters. The method uses a Thermo Scientific™ Dionex™ IonPac™ AS20 column set, on a recently introduced compact IC system coupled with a recently introduced single-plunger pump mass spectrometer. The selectivity of the mass spectrometer allows the quantification of perchlorate in high-ionic-strength samples at well below currently enforced action levels. Ionization improvements to the electrospray source eliminate the need to add organic solvent to enhance detection. Method detection limit (MDL) values in deionized water are 20-60 ng/L, and MDLs in high-ionic-strength matrix are 30-60 ng/L. The calibration curves for perchlorate in high-ionic-strength matrix at 101 μM over the range of 125-5000 ng/L using the external standard and external methods showed good linearity with the coefficient of determination being 0.9993, and 0.9998 respectively. Single laboratory precision in drinking waters, as measured by RSD, was < 5% at concentrations >150 ng/L perchlorate, and accuracy, was 95.6-102% for concentrations >150 ng/L perchlorate, and 111% for concentrations < 150 ng/L perchlorate. Single laboratory precision in high-ionic-strength matrix, was < 5% at concentrations >150 ng/L perchlorate, and accuracy, was 100-103.5% for concentrations >150 ng/L perchlorate.

MO278 NEW OPPORTUNITIES FOR THE NON TARGET ANALYSIS OF ENVIRONMENTAL CONTAMINANTS USING GAS CHROMATOGRAPHY- ORBITRAP MASS SPECTROMETRY
P. Silcock, Thermo Fisher Scientific / GC-MS; D. Cardona, Thermo Fisher Scientific / Environmental Analysis

Since the middle of the 20th century GC-MS has made a long journey towards its current status as one of the major analytical techniques used in a diverse range of applications. Despite this, GC-MS has had more than four decades to wait for a new type of mass analyzer with the potential to advance capability over previously applied technology. Almost two years on from the first commercial introduction of Orbitrap GC-MS in 2015, in this presentation, we explore how this technology has been applied specifically to the analysis of environmental contaminants and how this new application can be used to develop a new approach routine environmental analysis. Primary applications to be highlighted are the discovery of new disinfection by-products (DBPs) resulting from water treatment processes, using a non targeted approach, as well as the potential for addressing the difficult analytical challenges for a complex class of emerging persistent organic pollutants: short chain chlorinated paraffins (SCCPs).

MO280 HILIC workflow strategy for the hidden target screening of very polar compounds in surface waters
S. Veloutou, Technical University of Munich; S. Bieger, Technical University of Munich / Chair of Urban Water Systems Engineering; S. Grosse, T. Letzel, Technical University of Munich

Trace Organic compounds (TOCs) in water can be biogenic or anthropogenic. These compounds can range a lot in terms of polarity. Reverse Phase Liquid Chromatography (RPLC) is the most common and widely used tool for the separation of non-polar and mildly polar compounds. However, for the separation of very polar compounds, techniques like the Hydrophilic Interaction Liquid Chromatography (HILIC) are needed. HILIC has been established since years as an analytical tool, capable to separate effectively very polar molecules. Using a serial RPLC-HILIC system coupled with ToF-MS the analytical screening of samples comprised of solutes with variability in structure and polarity can be achieved. Full-spectrum acquisitions in non-target screening approaches are producing large datasets with the detected features of the samples. Different workflows have been published, proposing ways to cope with the collected amount of data in an automatic, time efficient and reproducible way, which can be applied to samples with various matrices. These workflows in a form of general steps can be summarized as: a) filtering and prioritizing the detected features (peak picking), b) molecular formula assignment, and c) a search in one or more compound databases. A successfully young compound database for water relevant compounds is STOFF-IDENT. In order to achieve a comprehensive identification of the water’s organic content, Non-target screening strategies have become increasingly popular. This study was realized by analyzing river water samples with the established RPLC-HILIC-ToF/MS system and by using the STOFF-IDENT compound database. Its main aim is to demonstrate and discuss an efficient strategy for the non-target screening of aqueous environments, as a mean to facilitate the process of identification of very polar compounds. Three 24h composite samples were collected using time proportional samplers; upstream and downstream of a WWTP and wastewater effluent. The samples were analysed by the established
RPLC-HILIC-ToF/MS system. The analysis data were then processed following a non-target screening workflow for very polar compounds. After importing the data to STOF-IDENT database, a proposed list of possible compounds in the samples was created. Using reference standards of the proposed compounds and MS/MS fragmentation data, it was possible to positively identify nine very polar compounds, of which six have not been reported previously in water surface samples.

MO281 Analysis of Per/Polyfluoroalkyl Substances (PFAS) in Drinking Water using LC/MS/MS to meet USEPA 537 requirements
T. Ananlo, L. Toellevi, T. Sosianski, Agilent
Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) at 70 ng/L. However, several other PFAS are also used in manufacturing and need to be monitored. To respond to this, a method was developed for the detection of PFAS in drinking water using a newly developed triple-quadrupole mass spectrometer and a modified high-performance liquid chromatography system. The USEPA has developed a method for analysis in drinking water for 14 PFAS and this method expands on that method with lower detection limits, and more QA/QC data. The water samples were extracted with solid phase extraction using a novel weak anion exchange cartridge which was optimized to achieve good recoveries for all compounds and will be presented. Several different classes of PFAS including perfluorocarboxylic acids (PFCAs), perfluoroalkanesulfonic acids (PFASs), sulfonamides (FOSA), sulfonamide acetic acids (FOSAAs) and others were separated on a liquid chromatography (LC) using a reversed phase C18 column. Since fluoropolymers are used in all LC systems, special precautions including replacing solvent lines and addition of a delay column were employed to avoid PFAS background contamination. The compounds were analyzed in negative electrospray ionization using a tandem quadrupole mass spectrometer in dynamic multiple reaction monitoring (MRMR) mode. Water samples were extracted using both an offline and automated online solid phase extraction techniques and the data was compared. All PFAS were analyzed and method performance parameters such as method detection limits, inter- and intra-day repeatability, matrix spike recoveries and other QA/QC criteria were evaluated. All recoveries were with 70-125% with %RSDs well below 15% that are needed to meet USEPA 537 requirements. Since PFOS and PFOA are detected in surface water samples, the method is flexible enough to be used in any lab setting for any type of drinking water samples. The distribution of PFAS is complex and needs to be monitored in written drinking water regulations. The two sampling sites (upstream vs downstream) were then compared using Mass Profiler Professional Software for the presence of other unexpected contaminants. The final confirmation of various substances of interest (e.g. PFOs) was investigated through the comparison with analytical standards. Results indicated that the non-targeted workflow optimized in this study can successfully identify unexpected chemical residues in fish matrices.

MO282 Optimisation of solid phase extraction parameters for the isolation and characterisation of benzodiazepines in wastewater
S. Nzube, Cape Peninsula University of Technology / Department of Chemistry; C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; V. S. Somerset, CPUT / Chemistry
Pharmaceutical pollutants entering the aquatic environment have become a growing environmental concern. The pharmaceuticals are known to have non-target effects on the aquatic environment. These compounds are nowadays widely detected in sewage wastewater. It is important to increase the emphasis on the characterisation of the benzodiazepines in order to differentiate them from industrial chemical compounds. In this study, various solid phase extraction techniques have been employed focussing on the isolation of benzodiazepines in wastewater matrices. Employing this method, it has been shown that different benzodiazepines, such as clonazepam and lorazepam, are benzodiazepines. Keywords: Benzodiazepines; Emerging pollutants; Solid Phase Extraction; Spectroscopy; Wastewater

MO283 Monitoring and drinking waters for Microcystins using online LC/MS/MS method
J. Westrick, Wayne State University / Lumigen Instrument Center; D. Cardona, Thermo Fisher Scientific / Environmental Analysis
In 2015 the USEPA announced an age-deciding drinking water Health Advisory (dWA) for the natural freshwater toxins, microcystins (MCs). For pre-school age children and adults, the MC dWA values are 0.3 μg/L and 1.6 μg/L, respectively. Although the dWA values are non-regulatory values, this announcement compels compelling health information that cannot be ignored. In parallel, EPA Method 544, a solid phase extraction/liquid chromatography tandem mass spectrometry (LC/MS/MS) method was released. Our goal was to create an online concentration LC/MS/MS method with 12 MCs that meets the EPA’s quality assurance/quality control (QA/QC) criteria. MC concentrations were measured in samples from freshwater lakes and drinking water. Samples were prepared by three freeze/thaw cycles, centrifuging, and filtering through a 0.25 μm polycarbonate filter. Our LC/MS/MS platform included an online sample concentrator with UHPLC for separation and a triple quadrupole mass spec for MS/MS analysis. This method included 12 MCs with LC retention curves from 0.5 – 500 μg/L with values greater than 0.996. The MCs eluted between 2.2 – 5.2 minutes allowing for the analyses time to be 3) MC-RR, [Asp]- MC- LR, MC-HiR, and MC-WR at concentrations above the low health reference level of 21 ng/L. Our data suggests that 1) by not including 12 MCs in Method 544, the true risk potential of exposure to MCs in drinking and recreational waters will be underestimated greatly, and 2) an untargeted approach may need to be made to monitor MCs. Finally, our LC/MS/MS method reduces sample preparation, chemical usage, and instrument and preparation time while meeting EPA quality assurance criteria.

MO284 Development of a LC-MS/MS-based method for screening of non-targeted chemicals of potential concern in northern pike
T. Lian, McGill University; J. Reiling, Université du Québec à Montréal / Department des sciences biologiques; J. Verreault, Université du Québec à Montréal / Department of Biological Sciences; M. Houde, Environment and Climate Change Canada / Aquatic Contaminants Research Division; S. Bayen, McGill University / Singapore-Delft Water Alliance
Fish and seafood contaminant monitoring traditionally relies on the surveillance of known chemicals, an approach referred to as targeted analysis. However, very few tools are available to monitor “unexpected” or “unknown” compounds. Non-targeted approaches are particularly useful to detect emerging contaminants in items related to the human diet such as fish and seafood. The non-targeted approach is however quite challenging for trace contaminant analysis as it involves isolating relatively high signal compounds from complex matrices, and this, in absence of a good knowledge about the analyte identity. In the past decade, the coupling of liquid chromatography, high-resolution tandem mass spectrometry (HRMS/MS) and advanced data processing algorithms has proved to be a robust approach for the analysis of unknown molecules in biological samples. In this study, a non-targeted workflow was developed with the objective to detect/identify unexpected organic contaminants in a predator fish from the St. Lawrence River (QC, Canada), the northern pike (Esox lucius), with a focus on chemicals originating from plastic materials. An optimized method was applied to pike tissue sampled upstream and downstream of the Montreal’s wastewater treatment plant. The two sampling sites (upstream vs downstream) were then compared using Mass Profiler Professional Software for the presence of other unexpected contaminants. The final confirmation of various substances of interest (e.g. PFOS) was investigated through the comparison with analytical standards. Results indicated that the non-targeted workflow optimized in this study can successfully identify unexpected chemical residues in fish matrices.
Chlorination could remove some aromatic emerging contaminants (ECs) in wastewater and allows for a prioritization of sites or compound groups for further in-depth studies.

**MO286**

Analysis of Phenanthrene Transformation Products Using High-Resolution Mass Spectrometry Coupled to High-Performance Liquid Chromatography

M. Leonard, Oregon State University / Environmental & Molecular Toxicology; S. Schlau, Oregon State University / Environmental and Molecular Toxicology; S.L. Mayorga Simonov, Oregon State University / Department of Environmental and Molecular Toxicology

Polycyclic aromatic hydrocarbons (PAHs) are environmental contaminants generated by the incomplete combustion of organic compounds. Several PAHs have been identified as toxic, mutagenic and/or carcinogenic, which has led to the United States Environmental Protection Agency (USEPA) to list 16 PAHs as priority pollutants. PAHs can be metabolized by mammals and some microbes to form hydroxylated PAHs (OHPAHs) and a variety of other transformation products (TPs). These TPs have the potential to be more toxic than their parent PAHs, but they are not included on the EPA priority pollutant list. Hence, they are often not screened for in environmental samples. Non-targeted screening based on high-resolution mass spectrometry (HRMS) coupled to high-performance liquid chromatography (HPLC) has made it possible to identify unknown TPs in complex environmental samples. An HPLC-HRMS method was developed for analysis of phenanthrene TPs detected in bioremediated water. C_{18} phenyl-hexyl, and fluoro-phenyl HPLC columns were evaluated for their ability to resolve hydroxypheanthrene (OH-Phe) isomers. Baseline resolution of 2-, 4-, and 9-OH-Phe was achieved with the C_{18} and phenyl-hexyl columns using a gradient of water/methanol mobile phase A) and a mixture of acetonitrile and methanol (mobile phase B). Gradient elution beginning with a relatively high percentage of organic solvent (70%) yielded satisfactory separation and peak shape without the use of an additive or buffer. Detection was carried out with a high-resolution time-of-flight MS employing electrospray ionization (ESI) in negative ion mode. The high organic solvent composition of the eluent enabled optimal ESI performance. Consequently, spectrometric sensitivity was preserved throughout each analysis. Further investigation will determine whether the fluoro-phenyl column is suitable for separation of OH-Phe isomers. The method will be used for separation of phenanthrene metabolites and other PAH TPs in non-targeted screening of bioremediated mixtures.

**MO287**

Strategies to monitor transformation products in the water cycle


Transformation products (TPs) are formed in the water cycle through both biological and technological processes. Data analysis showed that TPs in complex environmental samples could be more persistent and toxic than their mother compounds. Well-known examples are bromate and NDMA that generate toxic TPs after ozonation. Despite the TPs potentially increased toxicity compared to their parent compounds, transformation processes are not routinely monitored, and in particular those induced by drinking water treatment remain elusive. This lack of information is mainly due to the toxicological challenges: TPs, which are typically low concentrations occurring in low concentrations. Candidate analysis methods are bioassays to assess potential effects or advanced chemical analysis to elucidate TPs, such as non-target high-resolution tandem mass spectrometry (HR MS/MS) methods combined with novel data analysis approaches. Here, we addressed the challenges of TP analysis and the scarcity of TP research concerning studies in drinking water in particular, building on the insights gained from previous work. In a recent project, we assessed the relevance of transformation products as specific for the drinking water sector through interviews with the concerned parties. Based on the sector’s reported needs, we then performed a lab-scale pilot to monitor TP formation of the three organic micropollutants carbamazepine, clofibric acid and metal color during the rapid sand filtration and ozonation, two readily applied biotic and abiotic, drinking water treatments, respectively. The experimental results show that degradation of the parent compounds and TP formation are treatment and compound specific. In silico TP prediction and literature mining significantly facilitate TP identification, yet a number of TPs remains structurally unidentified, and for the majority of identified TPs toxicological risk assessment is missing.

**MO288**

Application of high-resolution mass spectrometry to identifying chlorinated transformation products of aromatic emerging contaminants in wastewater

X. Lin, TUNGHAI University; W. Chen, J. Cheng, TUNGHAI University / Department of Environmental Science and Engineering

Chlorination could remove some aromatic emerging contaminants (ECs) in wastewater, but may also convert the ECs into unknown transformation products (TPs). This study developed a method to systematically identify the TPs of multiple aromatic ECs using high-resolution mass spectrometry (HR-MS) and traced the parent aromatic ECs of the TPs. We spiked ten aromatic ECs (5000 ng/L) into 100-mL Milli-Q water. The water was chlorinated at an initial chlorine of 0.7 mg/L for ten minutes. The full-scan mass chromatograms of both the chlorinated (n = 6) and the untreated (n = 6) water samples were acquired using ultra-performance liquid chromatography-quadrupole-time-of-flight mass spectrometry. By comparing the compound profiles, we evaluated the removals of aromatic ECs and discovered new signals of suspect TPs. We also characterized the formation of the TPs using database searching and isotope-pattern comparison. The parent aromatic ECs of the TPs were then traced back by spiking each aromatic EC to one 100-mL Milli-Q water. Eight of the aromatic ECs were partly removed by chlorination, where triclosan showed the highest removal (99.4%), followed by bisphenol A (72.5%). Nine of the features that were present in the chlorinated and absent in the untreated water samples were indicated as TPs. The results of database searching and isotope-pattern comparison showed that the molecular formulae of all of the nine TPs contain at least one chlorine. Each chlorinated TP was then successfully traced to one aromatic EC. The nine TPs were transformed from five aromatic ECs, including all of the four parabens and triclosan, by replacing one or two hydrogens with chlorine atoms. The HR-MS method successfully identified nine chlorinated TPs. The results of this study demonstrated that parabens and triclosan could be transformed into more persistent, bioaccumulative, and toxic chlorinated compounds. The proposed method will be applied to the systemic identification of TPs in real water samples containing multiple ECs.

**MO289**

Unravelling the potential of a partial nitritation/anammox biomass towards micropollutants biodegradation

E. KASSOTAKI, ICRA (Catalan Institute for Water Research) / Technologies and Evaluation; M. PIJAN, Catalan Institute for Water Research ICRA / Technologies and Evaluation; I. GusaMARDI, Catalan Institute for Water Research ICRA; I. RODRIGUEZ-RODA, Universitat de Girona and ICRA / LEQIU/A; J. Aoss, Eawag Swiss Federal Institute of Aquatic Science and Technology; G. Buttiglieri, Catalan Institute for Water Research ICRA

In the past few years, anamox-based processes have attracted a lot of attention for their implementation at the mainstream line of wastewater treatment plants, due to the possibility of leading to energy autarky if combined with anaerobic digestion. However, little is known about the potential degradation of micropollutants by the microbial groups responsible of these processes and the few results available are inconclusive. This study aims to assess the degradation capability of biomass withdrawn from a partial nitritation/anoxic ammonium oxidation (PNA) pilot plant towards five pharmaceutically active compounds (ibuprofen, sulfamethoxazole, metropol, venlafaxine and carbamazepine). Batch experiments were performed under different conditions by selecting different microbial groups: i) regular PN/A operation, ii) aerobic (optimal for nitrifying bacteria), iii) aerobic conditions with allylthiourea (an inhibitor of ammonia oxidizing bacteria), iv) anoxic (optimal for anamox bacteria), v) aerobic with acetate (optimal for heterotrophic bacteria) and vi) anoxic with acetate (optimal for heterotrophic denitrifying bacteria). Ibuprofen was the most biodegradable compound, being significantly degraded under all conditions tested except heterotrophic denitrification. Sulfamethoxazole and metropol showed good percentages of removal under certain conditions (up to 70% and 62%, respectively), suggesting the specificity of different microbial groups towards the degradation of these compounds. Finally, carbamazepine and venlafaxine were hardly removed (≤ 10% in the majority of cases). Results demonstrate that the activity of different microbial groups in combination with altering operational parameters can actually enhance the removal of some of the studied micropollutants.

**MO290**

Removal of pharmaceuticals in a biofilm reactor: effects of manipulating co-degradation by carbon feeding on system performance

L. Zhang, Aarhus University / Department of Bioscience; P. Carvalho, U.E. Bollmann, H. El-taliawy, Aarhus University / Department of Environmental Science; H. Brix, Aarhus University / Department of Bioscience; K. Bester, Aarhus University / Department of Environmental Science

Pharmaceuticals are frequently found in the effluent of municipal wastewater treatment plants as conventional activated sludge systems are unable to completely remove these compounds. Biofilm reactors are a promising biotechnology to remove pharmaceuticals from treated wastewater. However, it is currently unclear whether the reactors from degradable carbon (enhancing the need of the microorganisms to go after difficult to degrade carbon) or increasing the load of organic carbon (assuming some carbon sources are more favourable for removing pharmaceuticals. Therefore, in this study, we built up a saturated sand filler based biofilm reactor to investigate the effects of intermittent acetate feeding on the removal of indigenous pharmaceuticals from treated wastewater. Presently, the sand biofilter was operated at 12 h of hydraulic retention time (HRT). In order to prevent adaption of the species composition of the biofilm to the presence of acetate, the system was intermittently fed with influent without carbon addition or with carbon addition. Ten acetate concentration levels were tested in this study, 5, 10, 20, 30, 60, 90, 120, 150, 200 and 300 mg C/L. For each feeding condition (without or with the different carbon concentration), the system was continuously...
operated for 1.5 HRTs, after which four samples were taken over 6 hours. The results showed that with the different acetate additions, the effluent oxygen concentration decreased, reaching the lowest value of 0.98 mg/L at 300 mg C/L acetate addition. However, the oxygen levels in the effluent increased almost to initial conditions (4.7 mg/L) in each starving phase between the feeding phases with acetate. The acetate addition resulted in three different compound dependent removal patterns in the phyllospheric and rhizospheric domains. Briefly, ammonium and inorganic nitrogen removal were attributed to co-metabolism (enhanced acetate). Metoprolol, isoproterenol, diclofenac, propranolol and sulfamethoxazole removal were removed 1) at lower acetate concentrations by co-metabolitic degradation dependent on aerobic turnover, and 2) at higher acetate concentrations limited by suboxic conditions. Moreover, sulfadiazine, sulfamethoxazole and trimethoprim were removed indirectly on the acetate degradation, which could be described as catabolism. Biofilm reactors can be employed for polishing treated wastewater, and the addition of primary carbon source can enhance the bioe reactor’s performance.

MO291 Investigating inhibitory effect of anti-inflammatory pharmaceuticals on activated sludge microorganisms
M. GREEN, E. Topuz, G. Yuksel, E. UBay Cokgor, D. Okutman-Tas, Istanbul Technical University / Environmental Engineering
The consumption of pharmaceuticals increase annually due to a variety of reasons involving affordability, population ageing and population growth. Due to the obstacles in monitoring all these micropolllutants regularly, focusing on priority micropolllutants that have been involved in the acute inhibition of microorganisms, there is still need comprehensive research to understand the toxicity mechanism of pharmaceuticals as well as to advance the modelling approaches. A laboratory-scale fill&draw 10L aerobic reactor (sludge age of 5 days; @22°C) was initiated with sludge sample taken from a municipal wastewater treatment plant located in istanbul. The culture was fed daily with a synthetic wastewater (ISO S892) (600 mg/ L COD and 10 mg/L PO4). To assess the acute inhibitory effects of these pharmaceuticals, microorganisms respirometric assays were conducted with pharmaceutical mixture (PMx) as dissolved in MeOH (10, 50, 75 g/L of each; Naproxen, Diclofenac, Ketoprofen, Mefenamic Acid, Ibuprofen, Indomethacin). Modelling studies were performed using modified Activated Sludge Model No.1 and Aquasim2.0 software. Pharmaceuticals were quantified with LC-MS/MS. Culture amendment with 10g/L PMx did not result in considerable change compared to control culture, but upon addition of a higher concentration (i.e., 75g/L) there was an increase in the initial substrate consumption rate and decrease in the OUR curve. A removal efficiency in the range of 33-55% was observed for tested pharmaceuticals at the end of the respirometric assays. Measurements showed that pharmaceuticals were not accumulated in sludge phase (<0.2%). Modelling studies reflected that the maximum hydrolysis rate of slowly hydrolysable COD (kCH) decreased from 0.84 to 0.72 1/day when the concentration of pharmaceuticals increased from 10 to 50g/L. When the concentration of PMx increased from 10 to 50g/L, an increase in the initial COD value of slowly hydrolysable COD was noticed. Furthermore, 75g/L PMx resulted in differentiation in organic matter structure which caused a change in the maximum respiration rate (kPMx). The results from this work will help to clarify toxic effects of micropolllutants on microbial systems as well as will provide valuable data for the discharge of these chemicals into the environment. This work is partially supported by TUBA-GEGBIP Award of Turkish Academy of Sciences and BAGEP Award of Science Academy Society of Turkey.

MO292 Elimination of tramadol and methadone in model ozonation experiments: removal kinetics and identification of transformation products
P. Kostanjevček, Rudjer Boskovic Institute; J. Cirklo, Faculty of Food Technology and Biotechnology; M. Matosis, Faculty for Food Technology and Biotechnology; M. Ahel, S. Terzic, Rudjer Boskovic Institute
Since the conventional wastewater treatment has proven to be ineffective for a number of pharmaceutical compounds, there is a high concern about their ever-increasing release into the aquatic environment. To mitigate this problem, advanced wastewater treatment technologies, such as advanced oxidation and membrane bioreactor filtration, have been proposed for the removal of recalcitrant pharmaceuticals. The aim of this study was to examine the removal of two opioid analgesics, tramadol and methadone, using ozonation. The experiments were performed in three different matrices, including pure water, phosphate buffer and secondary effluent from the Central wastewater treatment plant of the city of Zagreb. The removal rate for each compound was determined by ultra-performance liquid chromatography/quadrupole-time-of-flight mass spectrometry. The experiment showed that ozonation at an ozone dosage of 0.05 - 0.5 mg/L completely removed both opioid compounds in less than 5 min in pure water and phosphate buffer solution, providing that pH of the ozonation medium was higher than 7. The elimination of opioids was significantly slowed down at acidic conditions, which indicated the importance of the amino group deprotonation for an efficient reaction with ozone. Elimination of selected compounds in secondary effluent was much slower than in organic-free water matrices, reaching 91.1% and 99.1% in the time period of 10 minutes for tramadol and methadone, respectively. Reason for the lower elimination percentage is ozone depletion by reaction with other organic compounds present in the secondary effluent. The removal of parent compounds was associated with formation of two main transformation products characterized by m/z 250 and 280 for tramadol and 278 and 294 for methadone. The most abundant transformation products of tramadol and methadone were tentatively identified as tramadol N-oxide and EDDP, respectively.

MO293 Fate and transformation of persistent priority contaminants during potable water reuse: the challenge of producing safe water
C. Raimundo, UNICAMP / Institute of Chemistry; K.H. Cochran, B. Fryer, University of South Carolina; S. Kimura-Hara, University of Calgary; W. Abdelaheem, Y. Huang, University of Cincinnati; S.L. Coffin, University of California, Riverside / Environmental Toxicology; D. Schlenk, University of California, Riverside / Environmental Toxicology; D. Dionysiou, University of Cincinnati / Department of Biomedical, Chemical and Environmental Engineering (DBCEE); S.D. Richardson, University of South Carolina
Potable reuse of wastewater is becoming more common as populations increase and fresh water resources become more scarce. Producing safe drinking water from treated wastewater is challenging due to the presence of contaminants that are not removed or removed inefficiently in conventional wastewater treatment processes. Transformation products that can be formed with advanced oxidation technologies (AOTs) that are used in potable reuse treatments. These contaminants can be harmful for human and ecological health. In 2013, two Science Advisory panels determined two lists of priority emerging contaminants (ECs) to be monitored in aquatic ecosystems and human potable water reuse. The ECs were determined based on their potential for toxicity, persistence, bioaccumulation, and potential for transformation under potable water treatment conditions. This project is investigating the removal and/or transformation of 21 of these priority ECs through UV/ClO2, microfiltration and reverse osmosis in three samplings from Full-Scale Advanced Wastewater Treatment Plant (Orange County GWRS) in order to make indirect potable reuse of wastewater safer. Ultra performance liquid chromatography–tandem mass spectrometry (UPLC-MS/MS) was used to quantify bisphenol A, p-nitophenol, bis (2-ethylhexyl)phthalate, butylbenzyl phthalate, perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), diclofenac, ibuprofen, ethinylestradiol, 17α-ethinylestradiol, 17β-estradiol, estrone and chlorpyrifos. Gas chromatography mass spectrometry (GC-MS/MS) was used to quantify permethrin, galaxolide (CGO), polychlorinated dibenzo-p-dioxin (PCDD), polychlorinated dibenzofuran (PCDF) and diphenyl ether (PBDE)-99, bifenthrin and N-nitrosodimethyl-amine (NDMA).

Transformation products (TPs), disinfection-by-products (DBPs), and unknown compounds are being identified via high resolution-time-of-flight GC/TOF/MS/MS and UPLC/Q-TOF/MS/MS. Some compounds were not removed even after UV treatment. Controlled laboratory chlorination/bromination reactions have been performed on some of the ECs in our list to mimic drinking water and wastewater disinfection, and many TPs and DBPs were identified, including chlorine- and bromine-containing-by-products. Toxicity studies on these reacted samples were also done, and the results show that many of the TPs are more cytotoxic after being chlorinated/brominated. Mass spectra obtained from these identified TPs and DBPs are being added to a user library for use in determining TPs in our sampled waters.

MO295 Evaluation of a nano-adsorbent for the removal of metallic carcinogens from wastewater
C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; B. Silwana, Durham university; M. Makombe, Cape Peninsula University of Technology / Chemistry; E. Iwohua, University of The Western Cape / SensorLab Department of Chemistry; V.S. Somerset, CPUT / Chemistry South Africa is experiencing the worst drought in recent history, with water becoming a scarce commodity. However, the supply of good quality water is becoming increasingly challenged by a vast range of large-scale pollution caused by agricultural, domestic and industrial activities. Many technologies including coagulation, membrane process, dialysis, foam flotation, osmosis, photocatalytic degradation and biological methods have been employed for the removal of toxic pollutants from water and wastewater. These technologies are effective but have some disadvantages such as expensive equipment, high operational and maintenance, high energy requirements, generation of toxic residual metal sludge and incomplete metal removal. On the other hand, adsorption offers high efficiency, cost-effectiveness, easy handling and recovery of metals and other adsorbed species. Heavy metals are often found in wastewaters and the removal of these inorganic pollutants using bimetallic iron-based nanoparticles is still unclear. In this study, bimetallic iron-silver nanoparticles were chemically synthesized and investigated with chitosan to form bimetallic iron-silver nanoparticles (CS/Fe-AgNPs) to remove heavy metals from wastewaters. In this study, chitosan-iron-silver nanoparticles beads have been successfully prepared and its efficiency in the removal of Cd(II) under ambient temperatures has been evaluated. The removal
rate of total Cd(II) from actual wastewater was 89.25%. Furthermore, the monolayer adsorption capacity of Cd(II) based on the Langmuir model was measured to be 90 mg/g. Results were satisfactory when employing the adsorbent for removal of Cd(II) from wastewater samples. Keywords: Adsorption, Bioavailability, Monitoring, Wastewater.

MO296 WATER JPI Project FRAME: A novel framework to assess and manage contaminants of emerging concern in indirect potable reuse

Indirect Potable Reuse (IPR) provides options to maintain sufficient water quantities for reuse while protecting health and the environment. The project FRAME (A novel framework to assess and manage contaminants of emerging concern in indirect potable reuse) is funded by the European research initiative “Water JPI (Joint Programming Initiative, Water Challenges for a Changing World)”. Principal project aims are: i) to develop treatment processes with combined analytical, toxicological and microbiological approaches; ii) to evaluate advanced treatment options in a multiple barrier approach to improvement of CECS and inactivation of pathogens; iii) to integrate the experimental results in treatment process models and groundwater models to describe the fate of CECS; iii) to provide a decision support tool for stakeholders, considering process performance and feasibility assessment for treatment scenarios. Advanced treatment options are applied in a multiple-barrier approach at laboratory and full-scale, specifically to improve the removal of CECS, inactivation of pathogens and improvement of other health-related parameters. Detailed fate studies are included to elucidate transformation pathways of CECS and to identify transformation products (TPs) from biodegradation and biotransformation. Through comprehensive experiments using laboratory and full-scale reactors, the FRAME project aims to provide an integrated framework to assess the impact on health of CECS in the water delivery system, as well as the cost and operational feasibility of potential treatment options. This will enable drinking water utilities to develop strategies to ensure the safe provision of drinking water, in line with the World Health Organization's guidelines for protecting public health from CECS in drinking water supplies. The FRAME project is a collaborative effort involving scientists from various countries, including Italy, Germany, and the Netherlands, and will generate valuable insights for the development of effective and sustainable solutions to address the challenges posed by CECS in potable water supplies.

MO298 Sewage Epidemiology: Investigating the Impact of Phthalates on Human Health
C. Allen, L. Jones, Dublin City University / School of Biotechnology and DCU Water Institute; F. Regan, Dublin City University / Chemical Sciences; R.U. Halden, Arizona State University / Biodesign Center for Environmental Security; A. Staines, Dublin City University / School of Nursing and Human Sciences and DCU Water Institute; J. Lawler, Dublin City University / School of Biotechnology and DCU Water Institute
Phthalates are synthetic organic chemicals commonly used as plasticisers in polyvinylchloride and as additives in personal care products. Over 2135 kg of phthalates are produced globally each year with end use products including food containers, flooring, paints, and medical devices. Due to their high production volume and continuous release, phthalates are emerging contaminants ubiquitously in the environment. Research has shown that the widespread exposure to these chemicals has been associated with numerous adverse health effects including impaired reproductive health in males, decreased neurological development in children, cancer and obesity. As a result, some phthalates including DBP, BBP, and DEHP have been banned or limited in manufacturing (in particular for items such as children’s toys). As new research emerges indicating that substitute plasticizers also contribute to adverse health effects, these restrictions are likely to increase. The present project constitutes the first application of sewage epidemiology to determine phthalate exposure in an Irish population. Phthalate levels in influent, effluent and sewage sludge (biosolids) are being monitored by GC-MS and LC-MS/MS analysis, tracking the cycle of phthalates throughout the wastewater system. Phthalate biomarkers are being analysed in influent to assess phthalate exposure. A multi-analysis on health risk data serves to relate the level of exposure to an associated risk, providing the first step in phthalate risk assessment within the Irish environment. Results will inform on the feasibility of using sewage biomarkers for future compliance monitoring. Metabolites from the following phthalates are considered for examination: benzylbutylphthalate (BBP), di-n-butylphthalate (DBP), dibenzylphthalate (DHP), dibutylphthalate (DBP), di-2-ethylhexyl phthalate (DEHP), di octyl phthalate (DOP), dioctyl phthalate (DINP), diisononyphthalate (DINP), and diisodecyl phthalate (DIDP). This study is part of a large-scale project representing an international collaboration between three research centres Dublin City University (DCU), Arizona State University (ASU), and the Norwegian Institute for Water Research (NIVA). With support from Irish utilities, the team is assessing the sources, environmental fates and human exposure profiles of priority phthalates in Ireland. Study results on some eleven priority phthalates will be leveraged to inform risk assessments and environmental policies concerning the phthalate safety and usage.

MO299 Phthalates and their metabolites in the environment
L. Jones, Dublin City University / Biotechnology and Chemical Sciences; C. Allen, Dublin City University / School of Biotechnology and DCU Water Institute; F. Regan, Dublin City University / Chemical Sciences; A. Staines, Dublin City University / School of Nursing and Human Sciences and DCU Water Institute; R.U. Halden, Arizona State University / Center for Environmental Health Engineering; J. Lawler, Dublin City University / School of Biotechnology and DCU Water Institute
Phthalates are synthetic organic chemicals commonly used as plasticisers in polyvinyl chloride (PVC) and phthalates have been used in the plastics industry for more than 80 years. As phthalates are so commonly used, their impact on the environment and human health has been extensively studied. Phthalates have been found to be recalcitrant, ubiquitous in the environment, and in many cases, detrimental to human and animal health. This project represents an important collaboration between three research centres (DCU, ASU, & NIVA) with support from Irish Water, Panda and Fingal Co. Co., to assess the potential sources and environmental fates of priority phthalates in Ireland. This project is supported by several by studies carried out in Ireland already (DCU) and a vast array of literature in the area of priority pollutant monitoring. The impact of such study would be the analysis of these eleven phthalates from source to fate, in order to inform environmental policy on the risks posed by phthalate usage. The phthalates included in this study are: Benzylbutylphthalate (BBP), Di(2-ethylhexyl) phthalate (DEHP), Dibenzylphthalate (DBP), Diisopropylphthalate (DIPP), Diethylhexylphthalate (DEHP), Diethylphthalate (DHP), Dibutylphthalate (DBP), Di-n-octyl phthalate (DOP), Diisononylphthalate (DINP), Diisodecyl phthalate (DIDP) and Dimethylphthalate (DMP). A selection of phthalate monoesters have also been included in this study to evaluate human exposure to phthalates. Research into the human health effects of phthalates is far from complete, while phthalates including DBP, BBP, and DEHP have been banned or limited in manufacturing (in particular for items such as children’s toys), new research is emerging which indicates that substitute plasticizers also contribute to adverse health effects. This research is timely as the

A. Okeke, University / Chemistry
ABSTRACT Due to the lack of public pipe borne water supply in Owerri municipality and its Environs in Imo State, South-Eastern Nigeria, many individuals have developed different techniques for rainwater storage for drinking and domestic use. Consequently, it is very important to evaluate the quality of rainwater harvested and stored in these different storage tanks so as to ascertain their impacts on rainwater quality. In this study, samples of harvested rainwater were collected from four different storage facilities commonly used by individuals in Owerri (Metal drum tank, concrete underground tank, PVC rainwater tank, and Metal tank) and to inactivate their pathogen removal were implemented highlighting the need for a multi-scale approach to improve removal of CECs and inactivation of pathogens; iii) to assess the potential sources and environmental fates of priority phthalates in Ireland. This project is supported by several by studies carried out in Ireland already (DCU) and a vast array of literature in the area of priority pollutant monitoring. The impact of such study would be the analysis of these eleven phthalates from source to fate, in order to inform environmental policy on the risks posed by phthalate usage. The phthalates included in this study are: Benzylbutylphthalate (BBP), Di(2-ethylhexyl) phthalate (DEHP), Dibenzylphthalate (DBP), Diisopropylphthalate (DIPP), Diethylhexylphthalate (DEHP), Diethylphthalate (DHP), Dibutylphthalate (DBP), Di-n-octyl phthalate (DOP), Diisononylphthalate (DINP), Diisodecyl phthalate (DIDP) and Dimethylphthalate (DMP). A selection of phthalate monoesters have also been included in this study to evaluate human exposure to phthalates. Research into the human health effects of phthalates is far from complete, while phthalates including DBP, BBP, and DEHP have been banned or limited in manufacturing (in particular for items such as children’s toys), new research is emerging which indicates that substitute plasticizers also contribute to adverse health effects. This research is timely as the
extent of phthalate contamination within Ireland, and the impacts on human health, are unknown.

MO300 Poly- and perfluoroalkyl substances (PFASs) in the sewage system of the Bordeaux city: high contribution of unidentified precursors of perfluoroalkyl acids.

C. Simonnet-Laprade, University of Bordeaux UMR EPOC; P. Labadie, UMR CNRS EPOC Université Bordeaux / UMR 5805 EPOC; M. Capdeville, LyRE Centre de Recherche et Développement SUEZ; P.ardon, UMR CNRS EPOC Université Bordeaux / UMR EPOC 5805; H. Budzinski, University of Bordeaux

This study proposes to identify the origin of 30 poly- and perfluoroalkyl substances (PFASs) in wastewater in a French city (Bordeaux Metropolitan). For this purpose, 16 samples of domestic wastewaters, 10 samples of wastewaters impacted both by industrial and commercial activities were collected within the sewage network upstream typical and representative treatment plants; in addition 4 samples of runoff waters were also targeted in order to explore the input of this type of potential source. PFASs were also analyzed in the influents, the effluents, and the sludges of the 4 main wastewater treatment plants (WWTP) of Bordeaux Metropolitan to quantify global inputs to the natural aquatic environment. The results highlight distinct patterns and levels of contamination between different types of samples and potential sources. Overall, wastewaters impacted by industrial inputs have the highest levels (ΣPFAS as 4.6-501.7 ng L⁻¹) with the predominance of PFOS, PFHxS, C₆-C₁₂ PFCA and 6:2 FTSAs. High levels of 8:2 and 10:2 FTSAs (> 100 ng L⁻¹) were found in wastewaters from the harbor area and a major industrial area. Domestic wastewaters have the highest levels of 6:2 diPAP (median concentration of 4.5 ng L⁻¹), probably related to its use in food packaging. Concerning runoff waters, the highest levels are found in the airport area with ΣPFASs of 227 ng L⁻¹. The comparison of the profiles with those found for WWTP influents using a principal component analysis made it possible to highlight the importance of the industrial and commercial discharges on the global contribution to WWTPs. It has been possible to quantify global fluxes of PFASs to the four WWTPs and they were estimated at about 14 g day⁻¹ for the sum of targeted PFASs; concerning removal in WWTPs, only C₆-C₁₂ PFCA, PFOSs and their precursors with more than 8 perfluorinated carbons were shown to be partially or totally removed by the treatment processes. In addition to the targeted analysis and in order to estimate the proportion of unidentified perfluoroalkyl acid precursors, the total oxidizable precursors (TOP) assay developed by Houtz and Sedlack (2012) was applied to each of the matrices. This method, which was applied for the first time to domestic wastewaters and to WWTP sludges, revealed the presence of unidentified precursors of C₆-C₁₂ PFCA in all the matrices representing 32 % (in runoff water) to more than 90 % (in domestic wastewaters) of the total PFAS molar concentrations.

MO301 Antibiotics and endocrine disrupting compounds in wastewater treatment plants and in receiving water bodies around the city of Rome (Italy)


Several studies highlighted the occurrence of organic micropollutants such as pharmaceuticals residues, ingredients of personal care products and endocrine disrupting compounds in wastewater from urban and industrial districts. The occurrence of antibiotics and endocrine disrupting compounds (EDCs) in urban wastewater is of great concern because of their potential adverse effects on aquatic ecosystems and our health. The objective of this study was to investigate the occurrence and fate of selected classes of emerging and ED compounds in four WWTPs serving the city of Rome and in the receiving influent-effluent from WWTPs around the city of Rome and in contaminated sites along the urban stretch of Tiber and Aniene rivers. The results confirmed that WWTPs were the main source of river contamination. Although the effluent wastewater input into receiving water should produce a dilution of contamination, the continuous release of these xenobiotics into the aquatic environment may lead to chronic exposure of organisms at all levels of the food chain.

MO302 Mass flows of antimicrobial compounds in Swedish sewage treatment plants

M. Ostanan, J. Fick, M. Tysklind, Umea University / Department of Chemistry, University of Oxford / Department of Chemistry, University of Helsinki / Department of Chemistry and Biotechnology, University of Helsinki / Department of Chemistry and Biotechnology, University of Helsinki

Kim, National Institute of Fisheries Science; K. Roh, Pukyong National University / Department of Chemistry, University of Helsinki / Department of Chemistry and Biotechnology, University of Helsinki / Department of Chemistry, University of Helsinki

The continuous release of these xenobiotics into the aquatic environment may lead to chronic exposure of organisms at all levels of the food chain.
MO306 Drugs of abuse distribution in Turia River based on geographic information and ecotoxicological assessment
M. Andrés Costa, C.G. Slencu, A. Pascual-Aguilar, Y. Andreu, CIDE CSIC UV GV; Y. Rico, University of Valencia / Medicine Preventive

The aim of this study establishes the influence and the effects of the human pressure in a typical Mediterranean River Basin to determine accurately the point sources of contamination through an environmental forensics methodology. A total of 42 drugs of abuse and a set of environmental quality parameters were analyzed from 22 sampling sites in 2012 and 2013 distributed along the river. Analysis of the target illicit drugs was performed using solid phase extraction and liquid chromatography coupled mass spectrometry (SPE-LC/MS/MS). To determine spatial incidence of drugs of abuse, analytical results of target compounds were georeferenced and integrated into a geographical information systems (GIS). Ecotoxicological indices (i.e., sedimentological and biological indices) were determined to evaluate the risk associated with changes in the water treatment process and prevent population exposure to DBPs in the event of scenarios that may alter the good performance of the whole process.

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MO310 Formation of N-nitrosodimethylamine during water treatment for potable use: an update
B.G. Slencu, University of Medicine and Pharmacy Grigore T. Popa Iasi / School of Pharmacy; L. Avassilaci, I.D. Moraru, Grigore T Popa University of Medicine and Pharmacy of Iasi / School of Pharmacy

N-nitrosamines can form in water in specific conditions. N-nitrosodimethylamine (NDMA) is the most widely detected N-nitrosamine in drinking water which was subjected to chloramination. NDMA is also found in water subjected to disinfection with chlorine, hypochlorite or other chlorine-generating compounds, but in lower amounts. NDMA can also form through ozonization or nitrosation. Multiple mechanisms can be involved in NDMA formation: a) reaction between nitrogen oxides or dichloroamine and some anion exchange resins; b) formation of typical secondary amine precursors; c) chlorination of nitrite in the presence of secondary amines; d) catalytic formation on activated carbon, from secondary amines; e) UV or sunlight photolysis of nitrite, in the presence of secondary amines. Many organic nitrogenous substances can be NDMA precursors (pharmaceuticals, cosmetics, pesticides, amine-based polymers, etc), but not all can be present in significant amounts in the source water. In this work, NDMA was detected in a different sampling point of 2012 at a concentration of 14.02 (1.83–12.7) ng/L for BECG and 11.4 (2.29–40.1) ng/L for MET. GIS provided the spatial incidence of drugs of abuse along the Turia River Basin. The occurrence of these compounds near the city with highest population densities according to the descriptive model of territorial presence. Compounds used as drugs of abuse and prescribed as pharmaceuticals (MET, COD and EPH) were mostly detected in Valencia city and its metropolitan area where most hospitals are located. Although risk assessment showed low ecotoxicological hazard, further studies are also needed in order to assess long term toxicity.

MO308 UV filters in a tropical urban watershed
K. Gin, National University of Singapore / Civil & Environmental Engineering; F. Mao, National University of Singapore / Civil and Environmental Engineering; L. You, National University of Singapore; M. Reinhard, Stanford University; Y. He, Shanghai Jiao Tong University

A variety of benzophenone compounds (BPs) have been used as ultraviolet (UV) light absorbers in personal care products and synthetic products that are exposed to sunlight. Following use, BPs can enter ambient environments directly via retail material activity or indirectly from chemical discharges. Numerous studies have been conducted to detect the occurrence of BPs in the aquatic environments. However, the occurrence and fate of BPs in tropical waters remains poorly understood. In this study, occurrence and fate of seven BP-type UV filters (i.e., 2,4-dihydroxybenzophenone (BP-1), 2,2′,4′,4′-tetrachloro-hydroxybenzophenone (BP-2), 2-hydroxy-4-methoxybenzophenone (BP-3), 2,2′-dihydroxy-4,4′-dimethoxybenzophenone (BP-6), 2,2′-dihydroxy-4,4′-methoxybenzophenone (BP-8), 4-hydroxybenzophenone (4OH-BP) and 4,4′-dihydroxy-benzophenone (4DBH)) were investigated in a tropical urban watershed consisting of five major tributaries that discharge into a well-managed water body. The BPs concentrations were measured in four compartments, i.e., bulk water, suspended solids, pore water and sediments. Results showed that benzophenone concentrations varied from widely < LOQ to 122.6 ng L⁻¹ in dissolved phase and < LOQ to 2774 ng L⁻¹ in solid phases. Suspended solids in the water column contained significantly higher amount of BPs than sediments, while the concentration difference between bulk water and pore water was insignificant. Further study will evaluate the vertical concentration profile in the aqueous phases and in the solid phases. The concentration ratio of BP-1 to BP-3 will also be addressed, aiming at the degradation of BP-3 in the field. This will be followed by a preliminary risk assessment.
Toxicology and Risk Assessment TAYER Rey Juan Carlos University Historically, coastal and transition waters have preferentially been used for human settlement, leading to a continuous input of wastewater effluents into these habitats. Water quality monitoring of these systems, with the goal of improving their protection under the water framework directive is highly needed. The number of studies characterizing the presence of psychoactive pharmaceuticals (PPAs) in coastal waters and marine biota (Spanish paEF). Our work reports the first attempt at assessing these contaminants in the Rias Baixas area (North Western Spain). This area was chosen as the location for this study due to its economic and ecological importance as a national and global leader in shellfish (especially mussels) production. In this study, the presence of 16 PAAs (benzodiazepines and anxiolytics) was studied in samples of sea water and tissue from 7 economically valuable and highly consumed marine species. Samples were collected from 22 sites along the three main Rias Baixas. Fourteen out of the 16 assessed substances were detected in the water samples with venlafaxine (64%) and citralopram (41%) showing the highest detection frequencies. The highest concentrations in water were also measured for venlafaxine (291 ng/L), followed by lorazepam (95.90 ng/L) and citralopram (92.50 ng/L). Only 3 PAAs (alprazolam, citralopram and venlafaxine) were present in the collected biota samples (razor clam, clam and octopus) in concentrations up to 14 ng/g d.w. (citralopram), 3 ng/g d.w. (venlafaxine) and 0.31 ng/g d.w. (alprazolam). Hazard quotients (HQ), calculated from the measured concentrations in water and available chronic aquatic toxicity data resulted in values higher than 1 (indicating elevated hazard and possible risk) for venlafaxine, citralopram, and sertraline. The venlafaxine concentration (291 ng/L) in the AMFST F4 was higher than the MRL. Mussels risk assessment based on the measured tissue concentrations is underway. Our results confirm the presence of PAAs in coastal waters of the Rias Baixas area in concentrations potentially able to cause chronic effects in exposed organisms, as well as the presence of these compounds in biota inhabiting the area. Based on the results obtained further monitoring of venlafaxine and citralopram in coastal waters is recommended. It was possible thanks to the Spanish Ministry of Economy and Competitiveness FIS (PI14/00516) and the European Regional Development Fund (ERDF).

MO312 Determination of glyphosate and AMPA in fish bile from the Marne River, France H. Blanchaud, EPHE UMR 7619; T. Ferreux, F. Alliot, EPHE / UMR Metis; A. Goutte, UMR METIS EPHE Glyphosate is a widely used herbicide. In France, it is used during intercultural operations and to control weeds in non-agricultural areas. Glyphosate and AMPA (its main degradation product) can reach high concentrations in rivers, especially in the Seine basin including the Paris suburb (France). Although it is not bioaccumulative, the associated use of surfactants in pesticide formulations allows better assimilation in biological tissues. The aim of our study was first to develop a method to assess glyphosate and AMPA levels in biological tissues and then to determine the contamination of a freshwater fish, the European chub (Squalius cephalus). The AMFST F4 was fished in the Marne River (a tributary of the Seine River situated in the East part of Paris) at 4 sites characteristic of agricultural and urban areas. Water was also sampled for analysis to compare sites contamination. Bile is an ideal material to identify metabolites of pollutants. This biological fluid was taken directly from the gallbladder with a syringe on freshly euthanized chub and frozen for further analysis. Then, 100 mg of bile was taken to evaluate the concentration of 13A-Chloride (in water) added before extraction with nullIQ water (5mL) and ultrasonic method for 30 minutes. The extract was then derivatized (FMOC-Cl) and concentrated on SPE OASIS HLB cartridge (60cc) before LC MS MS analysis. Preliminary tests were performed to establish and validate the protocol and to find the lowest limit of quantification and the best reproducibility. Results showed that glyphosate is detected in a fish sample coming from the most contaminated site by AMPA. This suggests that glyphosate is assimilated in fish and is still detectable after glyphosate has been degraded to AMPA in the water river. Glyphosate content in fish could be an indicator of environmental contamination. Further developments are needed to validate the protocol and complete the study with other organs than bile.

MO313 From source to food: following emerging pollutants A. Garduno, The University of Nottingham; S. Pathasarathy, The University of Nottingham / Faculty of Engineering; J. Duran-Alvarez, Universidad Nacional Autonoma de Mexico / CCADET; C. Ortori, D. Barrett, The University of Nottingham / Faculty of Science; T.P. Dodsworth, The University of Nottingham / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering The current global population growth is putting an increasing strain on the world’s natural resources. Water is no exception; the current situation brings a surge in the use of wastewater treatment plant effluents release to the environment impairing water quality. The environmental presence of these compounds may cause negative effects in the exposed aquatic organisms. In order to evaluate the ecological risk that they may pose, a relevant methodology to analyse the relevant environmental matrices (i.e. water, soil and plants). This method will help determine the risk posed to humans, animals and the environment when reusing wastewater for irrigation. Furthermore it will aid in evaluating the natural attenuation of emerging pollutants in the agricultural environment and therefore inform on the level of treatment necessary to undertake this practice sustainably.

MO314 Psychoactive compounds in mussel: analytical method development and occurrence assessment E.L. Garcia, IDAEA-CSIC / Department for Environmental Chemistry; C. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; M. Lopez de Alde, Institute of Environmental and Water Research IDAEA-CSIC / Department of Environmental Chemistry It is well established that wastewater treatment plant effluents release pharmaceutical compounds to the aquatic environment impairing water quality. The environmental presence of these compounds may cause negative effects in the exposed aquatic organisms. In order to evaluate the ecological risk that they may pose, a relevant methodology to analyse the relevant environmental matrices (i.e. water, soil and plants). This relatively fast and simple methodology allowed the quantification of most of the target analytes at the low ng/mL level. Poor analyte absolute recoveries, which could be attributed to ionization suppression effects by matrix components, were obtained especially for cannabinoids. However, analyte losses and matrix effects are satisfactorily compensated by the use of deuterated analogues as surrogate internal standards. Fish and shellfish (marbled mussels, oysters and abalone) samples were collected from 7 sites along the three main Rias Baixas. Samples were collected from 22 sites along the three main Rias Baixas. Fourteen out of the 16 assessed substances were detected in the water samples with venlafaxine (64%) and citralopram (41%) showing the highest detection frequencies. The highest concentrations in water were also measured for venlafaxine (291 ng/L), followed by lorazepam (95.90 ng/L) and citralopram (92.50 ng/L). Only 3 PAAs (alprazolam, citralopram and venlafaxine) were present in the collected biota samples (razor clam, clam and octopus) in concentrations up to 14 ng/g d.w. (citralopram), 3 ng/g d.w. (venlafaxine) and 0.31 ng/g d.w. (alprazolam). Hazard quotients (HQ), calculated from the measured concentrations in water and available chronic aquatic toxicity data resulted in values higher than 1 (indicating elevated hazard and possible risk) for venlafaxine, citralopram, and sertraline. The venlafaxine concentration (291 ng/L) in the AMFST F4 was higher than the MRL. Mussels risk assessment based on the measured tissue concentrations is underway. Our results confirm the presence of PAAs in coastal waters of the Rias Baixas area in concentrations potentially able to cause chronic effects in exposed organisms, as well as the presence of these compounds in biota inhabiting the area. Based on the results obtained further monitoring of venlafaxine and citralopram in coastal waters is recommended. It was possible thanks to the Spanish Ministry of Economy and Competitiveness FIS (PI14/00516) and the European Regional Development Fund (ERDF).

MO315 MPHunter: a dedicated software for μFTIR Imaging Microplastic data analysis. First development steps and future perspectives A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; S. Primpke, G. Gerdtz, Alfred Wegener Institute / Shelf Sea System Ecology, M. Simon, N. van Alst, K.B. Olesen, F. Liu, J. Vollertsen, Aalborg University / Civil Engineering Department Imaging-Micro-Fourier Transform Infrared Spectroscopy (Imaging-μFTIR) applying a Focal Plane Array (FPA) is the most promising analytical tool for direct and rapid analysis of microplastics (MP) deposited on IR windows or collected on suitable membrane filters. The amount of data produced during an imaging analysis (many GB), combined with the lack of specific features addressed to MP identification, makes the environmental automation of commercial FTIR analysers possible. In this analysis the IR map extremely time consuming and partially operator dependent. Although a novel automatic analysis pipeline has already been developed by Primpke et al. (2017), the spectral identification is still performed using a commercial FTIR software, limiting the use of the pipeline to the FTIR software’s owners. Here we present a dedicated software (MPHunter) for MP analysis which can export, convert and manage datasets from the two FPA μFTIR Imaging suppliers. The software, which can manage several million single spectra and many...
thousands of reference spectra in one run, is written in RAD Studio (Embarcadero Delphi IDE), an object-oriented programming environment which allows easy construction of user-friendly interfaces. As an example, an imaging dataset of 196 tiles from a 128x128 pixel FPA detector (totaling 3.2 million individual spectra) can be easily managed using the software’s features. The software calculates the Pearson’s correlation coefficient between the unknown spectra and a reference spectral library. The correlation results can be further refined to define particles. The resulting spectra can be easily created and uploaded to the software as a .csv file. The calculation time for comparing 3.2 million spectra to a library of 150 spectra is around 6 hours on a standard laptop. Software features include conversion from %Transmittance to Absorbance and vice versa, selection of multiple customizable spectral ranges/whole spectral range for correlation and filters for residual noise removal. The calculation results can be further refined to define particles. Potential MP can then be marked, measured (main axes, area) and saved.

MPHunter is open source freeware. It allows a semi-automated MP identification and quantification, decreasing the time demand for the interpretation of FTIR-imaging data and increasing the data accuracy. Further improvements are ongoing to interface MPHunter to the Analysis Pipeline from Primpke et al. (2017) and use it as the searching engine.

MO316
From alpine regions to dense populated areas: A comparison of microplastic contamination between 15 rivers across Germany


Among marine litter, plastic waste is of growing concern, as nowadays it has become ubiquitous in the oceans. A large portion of the plastic waste is produced onshore and then enters the marine environment via water discharge to the river systems. Although, the oceans are considered as the main sink of plastic debris, recent studies also reported on the contamination of freshwater ecosystems with microplastics. Therefore, freshwater ecosystems do not only act as a source of plastic particles for the oceans, they also act, at least temporarily, as a sink. This may come along with all the associated harmful consequences that have been reported previously for marine ecosystems. Nevertheless, there is a considerable gap of knowledge about the impact and contamination of freshwater ecosystems with plastic particles. The lack of harmonized methods for microplastics sampling and detection hamper the comparability of data on concentrations and the composition of synthetic polymers in the freshwater environment. We compared microplastic contamination down to 20µm between 15 rivers across Germany, by the use of a harmonized sampling, sample processing and sample analysis (FTIR) currently validated by the JPI Oceans project BASEMAN. Results show a high variability between rivers and due to the lower size fraction measured relatively high concentrations to the few studies conducted in surface waters of freshwater ecosystems so far. Further, our data may shed light on major pathways and sources of microplastics in freshwater ecosystems. (M. Loeder, I. Schrank and H. Imhof contributed equally to the work as first co-authors).

MO317
Analytical approach for the identification and quantification of microplastic particles in environment samples by particle analysis in combination with FTIR and Raman microscopy

D. Frechel, Leibniz-Institut für Polymerforschung Dresden / Analytik; A. Kaeppler, J. Muche, K. Eichhorn, Leibniz Institute of Polymer Research Dresden; S. Oberbeckmann, Leibniz Institute of Baltic Sea Research Warnemünde; M. Labrenz, Leibniz Institute of Baltic Research Warnemünde

The detection of microplastic particles in an environment sample in the wide range from 1 µm to 5 mm nearly quantitatively in a reasonable time is a challenging task. 2 µm and larger particles are of special interest for marine environments, while sub µm particles are of concern in the freshwater environment. In this work, the sample preparation and analysis process is presented. The presented approach is based on inductively coupled plasma mass spectrometry, the use of a Pyrolysis-GC-MS coupling and Raman microscopy. The presented method is named MPHunter. The main advantage of this approach is that it allows the automatic identification and quantification of microplastics, but also provides detailed information about the chemical composition of the particles.

MO318
Using pyrolysis GC-MS in combination with multivariate tools to identify and differentiate polymer type and weathering of microplastics

T. Storslett, L. Sorensen, K. Almaas, SINTEF Ocean / Environmental Technology; M.O. Hepsø, Norwegian University of Science and Technology; O. Brakstad, A. Booth, SINTEF Ocean / Environmental Technology

Pyrolysis gas chromatography coupled to mass spectrometry (pyGC-MS) is a promising tool for identifying and quantifying trace amounts of microplastic (MP) in environmental samples. For pristine plastic samples, it has been demonstrated that polymer type and additive chemicals can be elucidated from the obtained pyrograms and attributed to the raw material source. However, for weathered plastics, the untargeted approach cannot be performed due to the complex chemical composition and the overlapping signals of different polymer molecules. Therefore, this study aimed to develop an untargeted analysis approach for the automatic identification of plastic particles using pyrolysis GC-MS in combination with multivariate tools.

MO319
Marine Microplastic: Production and characterisation of realistic test materials for studying ecosystem impacts


Reports studying the effective plastic litter on marine biota have almost exclusively utilised pristine plastic materials that are homogeneous in polymer type, shape, size and composition. The aim of this study was to develop a method to prepare realistic microplastic reference material (≤3 mm) for use in fate and effects studies. Weathered marine plastic litter (351 items) was collected from the coast of the island of Texel (The Netherlands) and carefully identified and categorised (fibre-based, packaging, foam, plastic boxes and jerry cans, bottles, gloves and misc). From these raw material, standard test particles and sheeting comprised ~70% of the collected material, which contained 9 different polymer types. The macroplastic material was sub-sampled and subjected to a cryo-milling and sieving process to create the plastic microreference material. To confirm that the original macroplastic polymer distribution was mirrored in the generated microplastic sample, it was subjected to ATR-FTIR and differential scanning calorimetry analysis. Particle size distribution (PSD) of the samples was determined by scanning electron microscopy. Statistical analysis showed that 68% (by mass) of the particles were in the range between 0.5 and 2.0 mm. Particle number increased with decreasing particle size fraction. Scanning electron microscopy revealed a wide range of particle sizes and shapes reflecting the properties of the different polymers. ICP-MS and ICP-OES analyses revealed the presence of a broad range of metals and other elements (e.g. Al, Cr, Fe, Mg, Pb, S and Zn) associated with the final sample. Many of these represent common inorganic plastic additives used as colourants, fillers and stabilisers. The additive organic chemical profile of the microplastic mixture was also determined by GC-MS following extraction by ethyl acetate and ultrasonication. A broad
MO320 Optimization of the preparation of standards of high density polyethylene microplastics and quantification techniques by stereoscopic and confocal microscopy. 

J. E. Nieto, University; J. Perales, CACYTMAR University of Cadiz / Department of Environmental Technologies; E. Rojo-Nieto, Helmholtz centre for environmental research - UFZ / Department of Cell Toxicology; J. Gonzalez-Leal, University of Cadiz.

A non-complex procedure has been developed for preparing HDPE microparticles as standard for microplastic determination in sediments. Always keeping environmental friendliness in mind, beetle caps from several brands were studied in order to identify those that could provide a clear spectrum for HDPE using Raman spectroscopy (considering that Raman spectroscopy is sensitive to those additive and pigment chemicals in microplastics that interfere with the identification of polymer types). Red caps from a popular brand of mineral water were selected as the raw material as their spectrum was easily comparable with those provided in the literature for HDPE. The large pieces of plastics were converted into microplastics by using a conventional machining process, i.e., a drill with a sandpaper implement (Dremel 300, 13 mm-60 grain size sandpaper). With this procedure, several sequential sessions of the machining processes were carried out in order to avoid changes in the physical properties of the plastics that would result from temperature increase due to due to prolonged friction. After the machining, the obtained HDPE particles were sieved using ethanol (96%) through two different mesh sizes until a final standard ranging from 0.1 to 0.850 mm size was achieved. This range was selected as it is relevant in biota ingestion risk as well as is appropriate for visual counting using microscopes. The standard HDPE microplastics used in all the extraction experiments were the same. It was thoroughly mixed previously to spiking in order to avoid differences in the distribution of size and standard HDPE microplastics were suspended in ethanol 96% and shook using a magnetic stirrer. An effective method for determining the particle distribution of microplastics is microscopy. In this work, two types of quantification using microscopy were used and compared: optical microscopy by visual sorting (Leica ICC50 HD, 4x lens, using a mesh for counting with sections of 3x3 mm prepared for this study) and, confocal microscopy (Zeta Instruments, model Zeta 300). The last one, included object detection algorithms (Mathematica 10) which not only allows quantification of plastic particles but also their classification into size groups.

MO321 First Report of Microplastics in Pacific-side Arctic Ocean

H. Lee, S. Kim, Incheon National University / Department of Marine Science; S. Kang, Korea Polar Research Institute / Division of Polar Ocean Science

The Arctic is one of the pristine areas that are sensitive to global environmental changes and have a relatively low environmental pollution. However, Arctic is already affected by floating microplastics (MPs) according to previous studies (38-234 pieces per 100 km²) and by microplastics in the Arctic polar water). Previous research on the Arctic has concentrated on the waters associated with the Atlantic Ocean (for example, the Barent Sea), while the Arctic Sea (e.g., the Chukchi sea, East Siberian sea, etc.) linked to the Bering strait has never been studied. This area can be particularly important because it links Asian marginal seas and the Pacific Ocean, which is regarded as a global hot-pot of MPs input to the ocean. We conduct annual surveillance in every summer since 2016 using a Norwegian icebreaker (R/V ARAON) to identify the presence, distribution, fate and effect of MPs in the Arctic Ocean connected with the Bering Sea. This is first result for the Pacific ocean-side polar region investigated in 2016 (Aug.-05/21/2016) & 2017 (Aug./06-25/2017) ARAON Expeditions. Here, we present the results observed in some media including seawater (surface and subsurface water), sea-ice core, and snow. Seawater samples were collected by manta-trawl net (200 mm mesh, n=12) for surface water, bongo net (330 mm; n=16) for subsurface water, sea ice (n=27) by ice-core, and snow (n=6). MPs were detected in all samples with average concentrations of 0.41 n/m³ (surface water in 2016), 0.55 n/m³ (subsurface water in 2016), and 1.20 n/L (in sea-ice core). We are progressing the analysis for sea-ice core samples. Generally, the data will be added later. It is generally known that plastics are light and float, therefore they could be enriched on the water surface layer. However, MPs abundance observed in the bongo net (subsurface water) was similar to that of the manta nets (surface water), which can be a strong evidence of the possible sinking of MPs into the deep water of the Arctic Ocean. On the other hand, the sea-ice’s contamination level was observed to be several tens of thousands higher than seawater. This indicates the necessity of further study on the trapping mechanism in the freezing process and the effect on the environmental change. The results of this study can be applied to further study on their major origins & mass balance of MPs in the Arctic Ocean, and contribution of MPs to environmental changes in the Arctic Ocean.

MO322 Analysing microplastics in samples of terrestrial systems

A. Mueller, E. Dümichen, Bundesanstalt für Materialforschung und -prüfung; F. Nieto, University of Cadiz / Department of Environmental Technologies; E. Rojo-Nieto, Helmholtz centre for environmental research - UFZ / Department of Cell Toxicology; J. Gonzalez-Leal, University of Cadiz; S. Kang, Korea Polar Research Institute / Division of Polar Ocean Science.

The occurrence of microplastics (MP), i.e. solid synthetic polymer particles between few micrometres up to five millimetres, in marine and limnic water systems, is already manifold documented. On the contrary, less is known about the occurrence and the fate of MP in terrestrial systems. In the ongoing discussion about the general monitoring of plastic pathways in the environment this is a gap, because MP in terrestrial environments could influence the quality of soil, but might be also relevant for the final transport of plastics into the aquatic environment, e.g. via erosion. In this regard, one critical point is the lack of harmonized or standardized protocols. The matrix of soils is usually more complex than the matrix of aqueous samples. For a first assessment of a potential exposure situation, there is a great variety of different methods to determine MPs in soils. (The goal of this work is the development of a systematic protocol for sampling, sampling pre-treatment and analysis of MP in terrestrial samples, which ends up in a fast, quantitative method. Up to now, various studies about the analysis of MP at beaches, in marine sediment and along rivers are available. In these studies, as sample pre-treatment density separation techniques were used to reduce the inorganic matrix. In some cases, a chemical oxidation step to minimize the organic matrix is additionally carried out. FTIR or Raman spectroscopy were used to analyse the sample with enriched concentrations of MP. Using these techniques, only small proportions of inserted samples were analysed. Similar investigations techniques were used for terrestrial samples. The few existing studies investigated sewage sludge, compost fertilization or areas of intensive utilization of plastics foils in agriculture or from relationship of microplastic contamination between sea salt and seawaters and sediments. The TED-GC-MS in various worst-case or rather polluted hot-spots (i.e. lea-compot, soil along frequently used roads). A special emphasis is given to easy and fast working steps and techniques for representative sample amounts. A quantitative assessment of highly occurring MP from littering (standard thermoplastics) as well as tire abrasion (synthetic elastomers) is intended.

MO323 Microplastics in Expanded Global Table Salt Product Samples and its implication

J. Kim, Incheon National University / Department of Marine Science; C. Kim, Graduate East Asia; S. Kim, Incheon National University / Department of Marine Science

In Plastic microplastic is becoming a global issue in marine environment pollution. Among the various environmental media, some recent studies have identified microplastic contamination that remains in salt (sea salt, lake salt, rock salt). As salt is an essential human/animal food-item, microplastic contamination in salt is a matter of concern. The current study utilized a chemical oxidation step to minimize the organic matrix is additionally carried out. FTIR or Raman spectroscopy were used to analyse the sample with enriched concentrations of MP. Using these techniques, only small proportions of inserted samples were analysed. Similar investigations techniques were used for terrestrial samples. The few existing studies investigated sewage sludge, compost fertilization or areas of intensive utilization of plastics foils in agriculture or from relationship of microplastic contamination between sea salt and seawaters and sediments. The TED-GC-MS in various worst-case or rather polluted hot-spots (i.e. lea-compot, soil along frequently used roads). A special emphasis is given to easy and fast working steps and techniques for representative sample amounts. A quantitative assessment of highly occurring MP from littering (standard thermoplastics) as well as tire abrasion (synthetic elastomers) is intended.
aerobic conditions of pristine and UV-weathered tire rubber in the presence of three different microbial inocula, i.e. activated sludge, soil particles and soil supernatant. Acetate and poly(D,L-lactide-co-glycolide) (PLGA) were used as positive controls in terms of readily degradable substrate and degradable plastic material, respectively. Pristine and weathered rubber exhibited low but measurable biodegradation levels in the presence of activated sludge (3.8—7.6% THOD) and soil particles, while no biodegradation was observed when using soil particles as inoculum. Accelerated UV weathering and higher biomass concentration was found to increase the biodegradability by activated sludge. Interestingly, increased response in terms of oxygen consumption was observed with acetate as co-substrate, indicating improved rubber degradability in the presence of a readily degradable carbon source. PLGA exhibited limited biodegradability and lowest biodegradation when using activated sludge as inoculum. Increased porosity and roughness on rubber surfaces over the course of the experiments, seemingly indicating degradation via surface colonization. Overall, ready biodegradability tests proved suitable to obtain information on degradation of car tire rubber. This study provides first evidence of their degradability, especially for weathered rubber in the presence of a co-substrate, which should be considered for future degradation studies. No in vitro assay of rubber on microbial activity was observed. PLGA as positive control in short-term tests is not encouraged due to its limited biodegradability. Future work should consider longer duration tests, which may be necessary to provide sufficient biofilm colonization of rubber particles, and assess other (abiotic) degradation mechanisms.

MO325
Evaluating sorption properties of tire materials using poly-parameter linear free-energy relationships (pplFER) M. Wehrhahn, University of Vienna / Environmental Geosciences; T. Hüffer, T. Hofmann, University of Vienna / Department of Environmental Geosciences Tires are common representatives of microplastics in the environment. They are introduced on the one hand as tire wear, an abrasion product, which reaches the environment via road runoff. On the other hand recycled and shredded tire rubber (TCR) is applied as filler material for example on turf fields. It was recently shown that tire materials are a substantial share (60%) on waste that is introduced into the environment as microplastic particles. Tires generally consist of a mixture of polypropylene (60-90%), mostly styrene butadiene rubber (SBR). These elastomers are compounded with carbon black or silica as reinforcing agent (20-35%), oils (15-20%) as softeners and extenders as well as vulcanizing chemicals (e.g., zinc oxide and sulphur (1-2%)). Although tire materials are known to pose the risk of leaching toxic substances, they are one of the most popular construction materials and are widely distributed for example in the application of artificial reefs. As particle material of the rubber particle may act to deliver chemicals to the environment. The precise characterization of molecular interactions between tire materials and (organic) compounds is therefore important to evaluate and predict the behaviour of tire materials in aqueous systems. Poly-parameter linear free-energy relationships (pplFERs) provide the opportunity to describe the contributions of individual molecular interactions to overall sorption processes taking into account both the physico-chemical properties of the sorbate as well as the sorbent. They have been successfully used to describe and predict sorption of organic compounds to various sorbents. This work hence intends to investigate sorption properties of tire rubber using poly-parameter linear-free energy relationships. [1] B. Liebmann, Mikroplastik in der Umwelt, 2015. [2] B. Bocca, G. Forte, F. Petrucci, S. Costantini, P. Izzo, Sci. Total Environ. 2009, 407, 2183. [3] C. Lavoine, Microplastics: Occurrence, Effects and Sources of Releases. 2015. [4] Y. R. Lin and H. Teng, Microporous Mesoporous Mater. 2002, 54, 167. [5] R. B. Stone, L. C. Coston, D. E. Hoss, F. Cross, Mar. Fish. Rev. 1975, 37, 18. [6] L. Alamo-Nole, O. Perales-Perez, F. R. Roman, Desalin. Water Treat. 2012, 49, 296. [7] M. Abraham, A. Ibrahim, A. Zissimos, J Chromatogr A. 2004, 1037, 29. [8] S. Endo, P. Grahovshoi, S. Haderlein, T. Schmidt, Environ Sci Technol. 2009, 43, 3094.

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Particle toxicity in the daggerblade grass shrimp (Palaemonetes pusio): micronized tire wear particles and microplastics L. Paige, Department of Biology; R. Leads, College of Charleston / Biology; S. Kell, College of Charleston / Graduate Program in Marine Biology; A.D. Gray, University of North Carolina at Greensboro / Biology Recent surveys of Charleston Harbor, SC (USA) have demonstrated >75% of total microplastics at some locations are tire wear particles (TWP). The aim of the present study was to investigate the toxicity of wet prepared TWP in adult grass shrimp (Palaemonetes pusio) and compare it to that of other microplastic particles. For our TWP assays, we conducted a 96-hour acute toxicity test and an immune challenge. Acute mortality was not observed at concentrations up to 100 g/L (1.9x10^7 particles/L). In our immune challenge, grass shrimp were exposed to TWP, polypropylene fragments, polyethylene spheres, polyester fibers, or sediment for 96-hours. Grass shrimp were then injected with either HEPEs-buffered saline or Vibriob composticus (5x10^7 CFU/shrimp). After 48 hours, no significant decrease in immune function was observed in exposed shrimp (p=0.8). We also conducted assays examining the size and shape dependent effects of microplastic particles (spheres, fibers and fragments), including TWP, on grass shrimp. Grass shrimp were initially exposed to various size fractions of plastic spheres (30, 35, 59, 75, 83, 116, and 165 µm), fragments (34 and 93 µm), fibers (34 and 93 µm), and TWP (50, 106, and 302 µm) at a concentration of 50,000 particles/L for three hours. Following exposure, grass shrimp were placed in particle-free water and monitored for survival, ingested and ventilated particles, and residence time in the gills and gut. Grass shrimp readily ingested and ventilated all tested particles. The time for mortality to be reached, however, ranged from 7-25 hours for rubber and 43±13.8 hours. Gut clearance for the TWP was 25±2.3 hours. Within the gill chambers the time for microplastics to be removed ranged from 27-45 hours with an average of 36.9±5.4 hours. Gill clearance for TWP was significantly longer than 51±2.1 hours. Mortality in these assays ranged from 0-55%, with microplastic spheres and fragments under 50 µm not acutely toxic. All sizes of TWP were not acutely toxic. Polyethylene fibers were most toxic in terms of both size and length and in vivo analyses to remove increased porosity and roughness on rubber surfaces over the course of the experiments, seemingly indicating degradation via surface colonization. Overall, ready biodegradability tests proved suitable to obtain information on degradation of car tire rubber. This study provides first evidence of their degradability, especially for weathered rubber in the presence of a co-substrate, which should be considered for future degradation studies. No in vitro assay of rubber on microbial activity was observed. PLGA as positive control in short-term tests is not encouraged due to its limited biodegradability. Future work should consider longer duration tests, which may be necessary to provide sufficient biofilm colonization of rubber particles, and assess other (abiotic) degradation mechanisms.

MO327
Acute and chronic toxicity of micronized tyre rubber to Hyalella azteca E. Khan, L.L. Halle, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment An average car tire lasts for 40000 km and during its life time 30% of the tire tread will emitted into the aquatic environment. Inevitably it interacts with aquatic biota. In comparison to the weight of research on the impacts of microplastics (MPs), there is little on micronized tire rubber (microrubber, MR). Recent reports have suggested that tire rubber contributes a significant proportion of ocean’s plastic and when rubber is found in the environment it is often classed with MPs, but MR is fundamentally different from MPs in terms of structural and chemical properties, and perhaps should be considered as a distinct pollutant. MR contains a suite of toxic substances; trace metals (notably Zn, Cd), polycyclic aromatic hydrocarbons (PAHS, such as pyrene) and assorted volatile organics used in vulcanization and as antioxidants (e.g. aniline) which have been shown to leach into the aquatic environment. Currently, little is known about the ecotoxicological impacts of MR. The present study was to conceived to determine the toxicity of tire rubber particles to Hyalella azteca, an established freshwater model organism, over acute and chronic exposures, and to delineate particle effects from those of the leachate. The acute toxicity (48 h) of MR particles compared to the MR leachate show similar LC50s (3426±172 particles/mL for MR and 3628±672 particles/mL for leachate), but significant differences are found at LC10 and LC90, suggesting that at low particle concentration the leachate is more important, but at high concentrations the particle may act to deliver chemicals in vivo following ingestion. The results of the 21 day study showed that mortality, reproductive output (neonate production) and net growth were significantly impacted at the higher exposure concentrations of MR. MR is an emergent contaminant of concern that is similar but distintic to microplastics in many aspects. Very little is known about the toxicity of MR, but our results show that MR exposure has short-term and longer-term toxicity on a key freshwater species.

MO328
Acute and chronic effects on Hyalella azteca and chemical analysis of rubber particles and leachate - comparison of pristine micronized car tire to previous data on worn car tire particles L.L. Halle, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment; K. Kumpmann, A. Jensen, Danish Environmental Analysis; F. Khan, Roskilde University / Science and Environment Microrubber (MR) from car tires constitutes a significant contribution to particulate matter in the aquatic environment it is often classed with MPs, but MR is fundamentally different from MPs in terms of structural and chemical properties, and perhaps should be considered as a distinct pollutant. MR contains a suite of toxic substances; trace metals (notably Zn, Cd), polycyclic aromatic hydrocarbons (PAHS, such a pyrene) and assorted volatile organics used in vulcanization and as antioxidants (e.g. aniline) which have been shown to leach into the aquatic environment. Currently, little is known about the ecotoxicological impacts of MR. The present study was to conceived to determine the toxicity of tire rubber particles to Hyalella azteca, an established freshwater model organism, over acute and chronic exposures, and to delineate particle effects from those of the leachate. The acute toxicity (48 h) of MR particles compared to the MR leachate show similar LC50s (3426±172 particles/mL for MR and 3628±672 particles/mL for leachate), but significant differences are found at LC10 and LC90, suggesting that at low particle concentration the leachate is more important, but at high concentrations the particle may act to deliver chemicals in vivo following ingestion. The results of the 21 day study showed that mortality, reproductive output (neonate production) and net growth were significantly impacted at the higher exposure concentrations of MR. MR is an emergent contaminant of concern that is similar but distintic to microplastics in many aspects. Very little is known about the toxicity of MR, but our results show that MR exposure has short-term and longer-term toxicity on a key freshwater species.

MO329
Applying nuclear techniques to study the biokinetics and toxicodynamics of
microplastics and co-contaminants in marine biota
C. Lacantot, International Atomic Energy Agency / Radioecology Lab; M. AL SID CHEIKH, University of Plymouth / Marine sciences and engineering; A.I. Catarino, Heriot-Watt University / Institute of Life and Earth Sciences; T. Cresswell, ANSTO Environmental Research / Institute for Environmental Research; B. Danis, Université Libre de Bruxelles; T. Mincer, Woods Hole Oceanographic Institution; F. Oberhaensli, P. Swarzenski, International Atomic Energy Agency / Radioecology Lab; I. Tolosa, International Atomic Energy Agency; H.K. Karapanagioti, University of Patras / Chemistry Department; M. Metian, IAEA-EL / Radioecology Lab

Despite recent efforts in understanding the risks associated with marine plastic pollution, there remains a great deal of uncertainty regarding the potential impacts of microplastics and nanoparticles on wildlife and humans. This largely relates to the methodological and analytical limitations associated with studying relatively low and environmental concentrations of these plastics. The IAEA Radioecology Laboratory, in collaboration with a team of external experts, is tackling these challenges by applying nuclear and isotopic techniques to address important outstanding questions on the risks of microplastics to marine organisms. Novel approaches using radiolabeled plastic particles and associated organic and inorganic contaminants are being developed to very precisely quantify their movement, fate and impacts on a range of aquatic biota, under controlled laboratory conditions. Nuclear techniques are uniquely suited for this research given their sensitivity and capacity to measure biokinetic and toxicodynamic parameters over time. As such, these tools will allow us to address important knowledge gaps, in particular the interaction between (1) the biokinetics, bioaccumulation and movement of microplastics and nanoparticles on their biological impacts of realistic concentrations of small plastic particles (< 100 μm) in marine biota; (2) the sorption kinetics of trace pollutants to microplastics; and (3) the influence of microplastics on the bioaccumulation of co-contaminants. Importantly, this research will allow us to test if microplastics can truly be bioaccumulated (i.e., cross epithelial membranes/tissues), and if they can act as a vector for contaminant transport in the marine environment under low exposure. This poster will provide an overview of the techniques used to address these questions, as well as preliminary outcomes and future directions.

MO330
Aggregation kinetics of plastic nanoparticles in fresh and marine phytoplankton culture media
S. venel, EPOC, University of Bordeaux / UMR EPOC 5805; J. Gigault, University of Rennes 1 / Laboratoire Geosciences Rennes; M. Baudrimont, Université Bordeaux 1 / UMR EPOC 5805

Release of plastics debris in the environment has been catching more and more attention in recent years. In particular, a recent review of 2019 detailed how the first studies, which were conducted recently, that plastics break down to produce nanoparticles due to photochemical degradation in marine waters. However, there is a lack of suitable analytical tools, and the environmental fate and transport mechanisms of nanoplastics have not yet been investigated. Indeed, several ecotoxicology studies investigate the impact of nanoparticles on aquatic organisms without addressing their aggregation state in aqueous media, whereas of (1) the biokinetics, bioaccumulation and movement of microplastics and nanoparticles on their biological impacts of realistic concentrations of small plastic particles (< 100 μm) in marine biota; (2) the sorption kinetics of trace pollutants to microplastics; and (3) the influence of microplastics on the bioaccumulation of co-contaminants. Importantly, this research will allow us to test if microplastics can truly be bioaccumulated (i.e., cross epithelial membranes/tissues), and if they can act as a vector for contaminant transport in the marine environment under low exposure. This poster will provide an overview of the techniques used to address these questions, as well as preliminary outcomes and future directions.

Mercury Biogeochemistries - Fate, Effects and Policy (P)

MO333
Influence of biofilm composition on mercury bioaccumulation

In aquatic systems, the dominant lifestyle of microorganisms (bacteria and microalgae) is to live together interlocked in exopolymers (EPS) substances (EP), rather than as single cells. Besides their involvement in several biogeochemical processes, biofilms are sites of accumulation and transformations of mercury (Hg). Their natural assemblage of heterotroph and autotroph microorganisms makes them an important entry point into aquatic food webs. The objective of the present study is thus to better understand the mechanistic processes that control Hg accumulation in biofilms and we focused on the elucidation of the role of biofilm composition on the kinetics of Hg uptake. For that end, two couples of biofilms were exposed to Hg in a marine environment. We found that the biofilm with a higher EPS content had a higher Hg accumulation rate. This indicates that the EPS composition is an important factor in Hg accumulation in biofilms.

MO334
Gaseous elemental mercury concentration and diurnal evasional fluxes from the water-air interface in coastal environments of the northern Adriatic Sea
S. Covelli, Dipartimento di Matematica e Geoscienze / Dept. of Mathematics and Geosciences; A. Acquavita, ARPA FVG; F. Floreani, E. Petranich, E. Pavoni, University of Trieste

Among pollutants widespread in the environment, mercury (Hg) is well recognised for its toxicity, mobility and bioaccumulation potential. In coastal areas, the presence of this element generates conflicts with important resources of profitable value such as fisheries and aquaculture. The Marano and Grado Lagoon (Adriatic Sea) experienced a double Hg impact. The first is due to the mining activity conducted at Idrijka (western Slovenia) for approximately 500 years, whereas the second is the result of discharge of a chlor-alkali plant effluents. Fish farming is a

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historical activity covering 14% of the total lagoon area. Recently, one fish farm was long-term monitored in order to understand the role of the sediment-water interface in recycling Hg and to estimate benthic fluxes and Hg mobility in the water column. An important further step toward a better comprehension of the Hg biogeochemical cycling in the lagoon environment, is represented by the estimate of its evasion fluxes, as gaseous elemental mercury (GEM), at the water-air interface. A continuous monitoring campaign coupled with speciation measurements (Lumes-RÁ-915+) has been used to measure GEM and to estimate the diurnal evasion flux at the water-air interface during three seasonal campaigns in four selected sites: two in a lagoon fish farm, one in the open lagoon environment highly impacted by Hg mining activities and the last one in an uncontaminated area of the Gulf of Trieste, the Bay of Piran (Slovenia). Accomplished to these monitoring efforts the background GEM level was determined together with the main chemico-physical parameters influencing Hg behaviour. This new insights will be of help for future estimates of Hg mass balance in one of the most contaminated areas in the Adriatic Sea. Keywords: atmospheric mercury; mercury fluxes; fish-farm; Grado Lagoon

MO335
Atmospheric mercury assessment: a contribution to global monitoring and effectiveness evaluation within the Minamata Convention
A. Fino, Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-IIA); F. Sprovieri, A. Macagnano, E. Zampetti, P. Papa, G. Esposito, CNR - Institute of Atmospheric Pollution Research Italy; P. Nicola, Instituto de Atmósfera e Clima (IAC).
In 2013, the Minamata Convention on Mercury was adopted by governments recognizing mercury as a pollutant of global concern for both human health and the environment. After reaching the 50th ratification the convention entered into force on 16 August 2017. According to the Article 22, the Conference of the Parties should establish of arrangements for providing itself with comparable monitoring data. The project was started with the submission of the Minamata site for the effectiveness evaluation of the environment as well as trends in levels of mercury and mercury compounds observed in biotic media and vulnerable populations on the basis of available scientific, environmental, technical, financial and economic information. UN Environment in close collaboration with Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-IHA) and WHO implemented a UN Environment - Global Environmental Facility (GEF) project entitled “Develop a plan for global monitoring of Human exposure to and environmental concentration of Mercury”, from late 2014. The project contributes to scientific knowledge for development of effectiveness evaluation mechanism. The main aim of the project was to harmonize approaches for mercury monitoring and to strengthen the capacity for mercury analysis in humans and in the environment. The experience made within the project suggests that there is a urgent need to coordinate the global efforts in atmospheric mercury monitoring by integrating existing monitoring programs worldwide in cooperation with other on-going programs such as GEO (Group on Earth Observation, www.earthobservations.org) and specifically with the GEO Flagship “Global Observation System for Mercury (GOS)”. The project is an attempt to support the policy process in relation to the Minamata Convention implementation. CNR-IIA proposed a selection of monitoring sites, mostly background sites but also including those highly impacted, to undertake passive sampling and analysis of Hg in ambient air in order to strengthen capacity to provide globally comparable data. The poster gives an overview of preliminary results coming from the pilot survey campaigns carried out with mercury novel passive sampling.

MO336
Assessment of Hg impacts on mountain river ecosystems
S. Le Faucheur, Institute F.-A. Forel, University of Geneva / Département F.-A. Forel des sciences de lenvironnement et de l’eau; F. Pierron, Université de Bordeaux / UMR EPOC CNRS 5805; C. Moniecart, Université de Genève; G. Dafre, University of Bordeaux / UMR EPOC CNRS 5805; A. Boullémat, RioTinto Mountain rivers are high-flow systems which can experience, even daily, high water height variations due to the presence of man-made upstream reservoirs. These river basins are remote environments due to its ability to be transported long distances in the atmosphere, and to be deposited far from the original source (Sunderland and Chnura 2000). Wetland ecosystems are important “hot spots” for mercury in eastern Canada, providing anoxic environmental conditions that promote the bacterial methylation of mercury. Methyl mercury is the most biologically available form of mercury available for reaction with solar radiation (i.e. reduction of Hg(II) to gaseous Hg(0)) in surface waters would significantly change over a summer. A Luzchem photo-reactor was used to irradiate 200 mL water samples in quartz beakers continuously exposed to ultraviolet radiation for 24 h with concurrent Hg(0) analysis to derive pseudo-first order gross reduction rates and batch experiments were used to derive net reduction rates (and gross reduction rates) by different benthic and fish-based biovectors – including mercury – and nutrients, which may indirectly affect metal speciation (Choy et al. 2010). The site for this study, Big Meadow Bog (Brier Island, Nova Scotia, Canada) has a history of ditching in the 1950s, which changed hydrology significantly, resulting in colonization by 3000 pairs of herring gulls (Larus argentatus) in the 1980s. To quantify changes in mercury mobilization and speciation in response to this ditching, groundwater, surface water, and lake sediments were sampled in 2009 and 2010. Results showed that the net photo-oxidation rates for freshwater lakes were low, with mercury reduction and oxidation reactions very close to being in balance. We also found that the amount of total reducible Hg(II) changed significantly in three of the lakes over several sampling months. Dissolved organic carbon concentration was a key factor positively correlated with these results. This research provides the first quantitative measurements of gross photooxidation and photoreduction rates as well as total photo-reducible mercury over a season in surface freshwater lakes.

MO338
Influence of Avian Biovectors on Mercury Speciation in a Wetland
J. Kickbush, Acadia University / Biology; M.L. Mallory, Acadia University / Biology; N.J. O’Driscoll, Acadia University / Engineering; S. Klapstein, Acadia University / Earth & Environmental Science; A. Loder, Acadia University; N.M. Hill, Fern Hill; N.J. O’Driscoll, Acadia University / Department of Earth and Environmental Science
Mercury is a persistent and bioaccumulative chemical that is present in many remote environments due to its ability to be transported long distances in the atmosphere, and to be deposited far from the original source (Sunderland and Chnura 2000). Wetland ecosystems are important “hot spots” for mercury in eastern Canada, providing anoxic environmental conditions that promote the bacterial methylation of mercury. Methyl mercury is the most biologically available form of mercury and the form which biomagnifies in food webs (Gochfeld 2003). A number of studies have been conducted to evaluate the role of avian biovectors – including mercury – as biovectors of mercury to freshwater ecosystems. For example, in the 1980s, to respond to this emerging as a key variable that requires more exploration. Here, we review the process of mercury Speciation in freshwater lakes. In this research, we have assessed mercury speciation in freshwater lakes in Keijmijk National Park, Nova Scotia, Canada. We examined the hypothesis that gross photoreduction and photoreduction rates would be significantly different in lake water. Another hypothesis was that the amount of mercury available for reaction with solar radiation (i.e. reduction of Hg(II) to gaseous Hg(0)) in surface waters would significantly change over a summer. A Luzchem photo-reactor was used to irradiate 200 mL water samples in quartz beakers continuously exposed to ultraviolet radiation for 24 h with concurrent Hg(0) analysis to derive pseudo-first order gross reduction rates and batch experiments were used to derive net reduction rates (and gross reduction rates) by different benthic and fish-based biovectors – including mercury – and nutrients, which may indirectly affect metal speciation (Choy et al. 2010). The site for this study, Big Meadow Bog (Brier Island, Nova Scotia, Canada) has a history of ditching in the 1950s, which changed hydrology significantly, resulting in colonization by 3000 pairs of herring gulls (Larus argentatus) in the 1980s. To quantify changes in mercury mobilization and speciation in response to this ditching, groundwater, surface water, and lake sediments were sampled in 2009 and 2010. Results showed that the net photo-oxidation rates for freshwater lakes were low, with mercury reduction and oxidation reactions very close to being in balance. We also found that the amount of total reducible Hg(II) changed significantly in three of the lakes over several sampling months. Dissolved organic carbon concentration was a key factor positively correlated with these results. This research provides the first quantitative measurements of gross photooxidation and photoreduction rates as well as total photo-reducible mercury over a season in surface freshwater lakes.

MO337
Mercury Photo-reduction and Total Photoreducible Mercury Dynamics in the Lakes of Keijmijk National Park, Nova Scotia
N.J. O’Driscoll, Acadia University / Department of Earth and Environmental Science; T. Christensen, Acadia University / Earth & Environmental Science; A. Fino, Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-IHA) and WHO implemented a UN Environment - Global Environmental Facility (GEP) project entitled “Develop a plan for global monitoring of Human exposure to and environmental concentration of Mercury”, from late 2014. The project contributes to scientific knowledge for development of effectiveness evaluation mechanism. The main aim of the project was to harmonize approaches for mercury monitoring and to strengthen the capacity for mercury analysis in humans and in the environment. The experience made within the project suggests that there is a urgent need to coordinate the global efforts in atmospheric mercury monitoring by integrating existing monitoring programs worldwide in cooperation with other on-going programs such as GEO (Group on Earth Observation, www.earthobservations.org) and specifically with the GEO Flagship “Global Observation System for Mercury (GOS)” or other monitoring programs. The project is an attempt to support the policy process in relation to the Minamata Convention implementation. CNR-IIA proposed a selection of monitoring sites, mostly background sites but also including those highly impacted, to undertake passive sampling and analysis of Hg in ambient air in order to strengthen capacity to provide globally comparable data. The poster gives an overview of preliminary results coming from the pilot survey campaigns carried out with mercury novel passive sampling.

In the present study confirms the need to address all compartments to properly assess the water quality of an aquatic system and therefore to understand potential impact of landfills and industrial sites on freshwater ecosystems.
Organohalogen and mercury residues in fish from the Western Mediterranean Sea: concentrations, bioaccumulation and dietary exposure.

D. E. Junqueira, Instituto de Environmental Assessment and Water Research (IDAEA-CSIC); M. Gari, IDAEA-CSIC / Environmental Chemistry; R. Luill, General Direction of Public Health and Consumption; J. Grimalt, Instituto de Estudios Ambientales y Agua (IDAEA-CSIC)

Organochlorine compounds (OCs) and mercury (Hg) have diverse deleterious health effects and are persistent in the environment. They tend to bioaccumulate and biomagnify along the food chain. Diet is the major source for the incorporation of these pollutants into humans, especially through consumption of fish. This research focuses on the presence of OCs, total mercury (THg) and methylmercury (MeHg) in lean fish from the Western Mediterranean Sea. Determinant factors of these concentrations such as trophic level and weight of fish have been studied. The estimated weekly intake (EWI) from the Spanish population of these pollutants has been assessed. Samples were collected between March 2015 and August 2016. Most of them were from Balearic Islands (Majorca n=67, Menorca n=17, and Ibiza n=18) and the rest of the samples were from Tunisia (n=2) and Egypt (n=1). Additional fish samples were collected from the Atlantic Ocean, in front of Senegal (n=4) and Mauritania (n=10) coasts for comparison. The OCs levels found in fish were similar or lower than in other previous studies. In contrast, 15% of the most frequently fish species consumed by the Spanish population had Hg concentrations above the maximum level set forth by the European Union MRL for human consumption. The concentrations of OCs and Hg between trophic levels have also been compared. Except for HeCB, the values were higher in the upper trophic level with statistically significant differences for ΣDDTs and ΣPCBs (p < 0.05). The relationship between fish weight and pollutant concentrations were also studied. A positive relation between Hg concentrations and weight was found (R²=0.58; p-value= 0.001). This trend was not observed for any other OC. The concentrations found in dusky grouper from the Mediterranean Sea and Atlantic Ocean were also compared. The former group presented higher levels for ΣDDTs, ΣPCBs and Hg (p < 0.05). The estimated weekly intake of OCs were well below the reported Tolerable Intakes. However, for Spanish population that only consume Mediterranean fish, the estimated weekly intake for Hg (4.42 µg/kg bw) exceeded the provisional tolerable weekly intake for adults and children (0.3 µg/kg bw). Comparisons by others between the first two studies (1980 and 1998) had suggested an increasing trend of mercury in fish. Assessment of the mercury concentrations in fish caught in 2015 against those reported in the previous studies found that the concentrations have remained relatively stable from 1980 to 2015, regardless of the location from which fish were collected. There was no indication of increasing concentrations of methylmercury. The concentration of mercury in the Atlantic Ocean samples were lower than the maximum levels set forth by various international and national institutions. While some variation was observed in the levels of mercury in fish between studies, this variation appeared to be due to differences in the size and age of fish between studies, rather than a result of increasing availability of mercury to fish.


H. Coelho Vieira, University of Aveiro; J. Von Osten, Autonomous University of Campeche / Instituto EPOMEX; A. M. Soares, F. Morgado, University of Aveiro / department of Biology & CESAM; S. Abreu, University of Aveiro / Dep. Biology & CESAM

Fish consumption is linked to the prevention of some human diseases, especially cardiovascular and neurological disorders, due to the content of high-quality protein, vitamins and n-3 fatty acids. At the same time, fish consumption is considered a major pathway of mercury (Hg) exposure in human. More than 90% of this Hg present in fish tissue is found essentially in its organic form (methylmercury (MeHg)), which is the most toxic form of Hg. Due to the potential adverse human health effects, international agencies have established Reference doses (RDI) as recommendations to Hg intake. Some studies have been associating the fish consumption with the Hg bioaccumulation, in areas along the Mid-Atlantic Ridge (MAR) exposed to active hydrothermal fields. The Azores archipelago is located in the North Atlantic Ocean close to the MAR. The last fishery statistics for fish consumption per capita in the Azores archipelago shows that, each Azorean consumes about 80 kg of fish per year being the region with the highest consumption of fishery products in Portugal. This study is the result of a review of all published articles indexed in Web of Science that presented Hg concentration in the muscle for fish species captured in the Azorean Exclusive Economic Zone, and additional new data from fish obtained by recreational fish. The selection of species was based on the fish landing reports (1994-2015) of Azores Fisheries Statistics (SAGA). The Azores archipelago ports. At the about 10000 tonnes per year of these commercial fish species are discharged. Despite low Hg levels in fish, every year the population of this area is exposed to more than 1500g of Hg via fish consumption. However, the species with the highest concentrations of Hg are not always those that contribute to a higher human exposure. The fish species Mora moro exhibit higher values than the permitted for fish consumption and carruafados species generally exhibit higher concentration of Hg than omnivores species. On the other hand, demersal fish species demonstrated higher Hg concentration than pelagic fish species. Finally, the target hazard quotient (THQ) is < 1 for all fish species, meaning that the level of exposure is lower than the reference dose, and indicating that the daily exposure is not likely to cause any negative health effects during a lifetime in the human population.

Mercury concentrations in black meat from the Gippsland Lakes, Victoria, Australia.

L. Mejia EE, EPA Victoria / EPA Victoria; S. Balshaw, Department of Health and Human Services; R. Goudey, EPA Victoria

The Gippsland Lakes are a coastal lakes system in eastern Victoria, Australia. They represent a unique aquatic ecosystem of significant ecological significance (Ramsar classified) as well as supporting significant tourism, recreational and commercial fishing industries. The Lakes area has been subject to several contaminant monitoring investigations over the last 45 years that have identified sediment and soil samples with detectable mercury concentrations, often exceeding screening levels set to protect the environment, aquatic plants and animals. The sources of mercury to the Lakes have been identified as having anthropogenic origins. Historic sources are gold mining and wastewater discharges from a paper mill. Ongoing sources of mercury include emissions from coal-fired power plants in the Latrobe Valley to the east of the Lakes and wood smoke from household and planned burns. This study, conducted in 2015, aimed to determine if the concentrations of mercury in black meat had increased over time, and whether or not existing dietary advice issued nationally by Food Standards Australia New Zealand for the protection of consumer health against the effects of mercury in seafood, was appropriate for fish sourced from the Lakes. Three previous studies investigated the concentrations of mercury in fish from the Lakes and found that fish were below the maximum levels. Comparisons by others between the first two studies (1980 and 1998) had suggested an increasing trend of mercury in fish. Assessment of the mercury concentrations in fish caught in 2015 against those reported in the previous studies found that the concentrations have remained relatively stable from 1980 to 2015, regardless of the location from which fish were collected. There was no indication of increasing concentrations of methylmercury. The concentration of mercury in the Lakes has been assessed. Samples were collected from the Lakes. The average mercury concentration in black meat was 4.42 µg/kg bw. The equivalent estimations for Mediterranean fish, the estimated weekly intake for Hg (4.42 µg/kg bw) exceeded the provisional tolerable weekly intake for adults and children (0.3 µg/kg bw). Health risk was calculated using USEPA equations. Of the 52 “fish samples” analyzed 61.53% were identified as sharks of the following species: Leopard (Galeocerdo cuvier), Common sawshark (Pristiophorus cirratus), Goblin (Mitsukurina owstoni), nurse (Ginglymostoma cirratum), whale shark (Rhincodon typus), scalloped hammerhead (Sphyrna lewini), daggersnose (Isosogphodon oxyrhynchus), silky (Carcharhinus falciformis). With regards to the health risk, when considering the lowest Hg concentration, children may eat only one 188 g portion/month, while fertile women and older people, two 190 g portions/month and men up to five 260 g portions/month. While considering the average Hg concentration, the number of portions/month is drastically reduced to less than one portion per month. If the amount of portions described before are respected, the calculated risk for babies was 0.83 but significantly reduced later in life if the lowest Hg concentration is considered. However, when calculating the risk with the average Hg concentration the risk quotient was always above 1 and up to 7.2 for babies. In conclusion there is a health risk when eating fish that cannot be identified, so people must buy whole fish to secure their identity and authorities should implement a monitoring program to penalize the sale of shark meat as fish meat.
industrial, agricultural and harbor activities, which impact the environment through the release of contaminants such as metals. Among these metals, mercury (Hg) is highlighted due to its toxicity and capacity of biomagnification. In the Paranaguá estuary, in the state of Paraná, and in the Cananéia estuary, state of São Paulo, these potentially polluting activities are present in different levels. However, these regions comprise the largest remnants of the Atlantic Rainforest ecosystem, fact that gives them the character of World Heritage site and biodiversity hot spot (UNESCO), therefore a environmental monitoring and conservation acts of the areas are necessary. Thus, this study investigated the concentrations of Hg and nitrogen isotope ratio (δ15N) in the trophic web composed by benthic invertebrates, benthivores fish (Stellifer rastrifer, Paralobodon brasiliensis and Isopisthes parvipinnis) and marine mammals (Sotalia guianensis and Pontoporia blainvillii), to understand the trophic dynamics of Hg and compare these estuaries. Samples were taken in the summer of 2015; analyses of δ15N were carried out by Elemental Analysis - Isotope Ratio Mass Spectrometry (EA-IRMS), and mercury analyses were carried out by Optical Emission Spectrometry, Inductively Coupled Plasma with Vapor Generator Accessory (OES-ICP-MS), in the muscular tissue of the organisms. The results of δ15N varied from 6.4 to 13.8 % in Paranaguá and from 7.1 to 14.3 % in Cananéia, with continuous enrichment among the trophic levels. Concentrations of Hg were significantly higher in Paranaguá (0.02 to 5.8 mg kg−1) than in Cananéia (0.02 to 0.9 mg kg−1), with maximum values in marine mammals, followed by invertebrates benthic and fish. Through linear regressions between Hg and δ15N, positive correlations were observed only in Paranaguá, but they were not significant, which indicates a trend of biomagnification of this element. Such a behavior is expected since the input is greater from anthropic activities than Cananéia, and presented similar values to highly degraded Brazilian estuaries, such as Santos Bay (SP) and Guanabara Bay (RJ). The results showed a current panorama of the trophic distribution of Hg in these estuaries being a useful tool in environmental monitoring and coastal management in regions of great ecological importance.

**MO345 Use of green tea to reduce mercury and methylmercury bioaccessibility in raw and cooked fish**

V.F. Barbosa, Portuguese Institute of Sea and Atmospheric IPMA / Division of Aquaculture and Seafood Upgrading; P. Anacleto, Instituto Português do Mar e da Atmofsera (IPMA) / Division of Aquaculture and Seafood Upgrading; R. Alves, King Abdullah University of Science and Technology (KAUST); A. Maulvault, Instituto Português do Mar e da Atmofsera (IPMA) / Division of Aquaculture and Seafood Upgrading; F. Fogaça, Embrapa; T. Langerholc, Faculty of Agriculture and Life Sciences, University of Maribor; A. Marques, Portuguese Institute of Sea and Atmospheric IPMA / Division of Aquaculture and Upgrading

Human exposure to mercury (Hg) and methylmercury (MeHg) increases in diets rich in high trophy level marine species, which harbor high levels of contaminants through trophic food web. Nevertheless, the overall concentration of Hg and MeHg detected in seafood does not always reflect the amount that will be available for absorption by human intestinal epithelium after the digestion process. On the other hand, several studies have highlighted the health benefits attributed to green tea consumption and their potential effects on reduction of bioaccessibility of contaminants. In this context, the aim of the present study was to assess the effect of green tea in Hg and MeHg bioaccessibility in raw and cooked marine fish species. Results demonstrated that total Hg and MeHg concentration in seafood does not reflect the bioaccessible fraction. Hg bioaccessibility in raw samples ranged between 60% (yellowfin tuna and black scabbardfish) and 37 % (European conger), with most species presenting a bioaccessibility below 50%. Moreover, after grilling, Hg/MeHg bioaccessibility significantly decreased in all species, ranged between 31% (yellowfin tuna) and 8% (Atlantic wreckfish). The bioaccessibility of Hg and MeHg was also affected by the presence of green tea, decreasing the amount of these contaminants. In raw samples with tea, Hg bioaccessibility ranged between 47% (black scabbardfish) and 26% (swordfish); and between 18% (yellowfin tuna) and 7% (swordfish) after grilling. Green tea significantly decreased Hg/MeHg bioaccessibility in raw samples of yellowfin tuna, common smooth-hound and swordfish, as well as in grilled yellowfin tuna, common smooth-hound, Atlantic wrekfish and blue shark. Bioaccessibility variability may be explained by changes in the chemical composition of species during grilling and green tea catechins bioaccessibility, oncology are relatively unstable. This work clearly reveals that green tea is able to reduce Hg and MeHg bioaccessibility, leading to lower the risks associated with seafood consumption. Nevertheless, a better understanding of green tea bioaccessibility is needed, and how its protective effect affects other contaminants. Such information is certainly useful to help consumers to wisely select their food, and to enable food safety authorities to integrate this information in risk assessment and communication activities.
hispidula in the upper Felidia river basin, Colombia
W. Correa Barragán, G. Duque, Universidad Nacional de Colombia / Facultad de Ingeniería y Administración, Departamento de Ingeniería; P. Cogua, Universidad Santiago de Cali; S. Cuero Salazar, Centro de Diseño Tecnológico Industrial - SENA Regional Valle
The upper basin of the Felidia River, located in the Paraltenos National Park of Cali, Colombia, is subject to different anthropogenic stressors, such as mercury, the product of illegal mining. Using a direct quantification method (EPA 7473), it was studied the variation of total mercury (HgT) in the specimens of the riparian fern Thelypteris hispidula, sediments and water in three streams: El Socorro, El Roble and El Pato, during the dry season, dry-rain transition and rainy season. Using non-parametric statistics (Kruskal Wallis), significant differences were found in the HgT concentrations between the dry and rainy seasons. The total Hg content was highest in the rainy season (p = 0.055), accumulating mainly in El Socorro. The HgT in the root of the plants presented differences in distinct sampling times (p = 0.005), increasing in the rainy season. The Spearman’s bivariate correlations showed that the dynamics of HgT accumulation in the root, is directly related to the concentration of HgT in the stem (rho = 0.918, p = 0.000) and leaves (rho = 0.900, p = 0.000). It was also evidenced that the accumulation of HgT in the root, is influenced by the concentration of HgT in the sediments (rho = 0.764, p = 0.001). These results demonstrate the environmental effects caused by mining activities in protected areas in Colombia.

M0349
Temporal integration of diurnal variations of metals and mercury concentrations by passive sampling method in a highly polluted site on the Delre River, northern France
M. Berteig, Irsea Centre de Lyon - Villeurbanne; a. darbin, Irsea / Unité de Recherche Mille Aquatiques, Ecologie et Pollutions (MAEP); G. Billon, L. Lesven, Université de Lille1, Sciences et Technologies / Laboratoire de Spectrochimie Infrarouge et Raman; G. Grisot, Irsea Centre de Lyon - Villeurbanne / Unité de Recherche Mille Aquatiques, Ecologie et Pollutions (MAEP); P. Superville, Université de Lille1, Sciences et Technologies / Laboratoire de Spectrochimie Infrarouge et Raman; L. Dheret, M. Coquery, Irsea Centre de Lyon - Villeurbanne / Unité de Recherche Mille Aquatiques, Ecologie et Pollutions (MAEP)
Due to several metallurgical plants along the river, the Delre River is a highly polluted site in the northern France. Previous studies showed that sediments are polluted with Cd, Pb, Zn and Hg (Vdovic et al., 2006). Moreover, intense fluvial traffic generates regular resuspension of sediments leading to diurnal variations of metals concentrations in the dissolved and particulate phases. This was previously highlighted by in situ voltammetry approaches allowing to measure Pb, Zn and Cd with a high frequency data acquisition (Superville et al., 2014). However, these measurements could not be performed for Hg with such probes, while previous field deployment of DGT (Diffusive gradient in Thin films) passive sampler suggested such variations. Indeed, time weighed average concentrations were 20 times higher (20 ng/l) than those measured in grab samples (1 ng/l). Thus, a field campaign was conducted during 15 days to assess diurnal variations of metals and Hg concentrations (dissolved, particulate and labile phases) related to fluvial traffic in the Delre River, in the city of Aubry, downstream a metallurgical plant (Umicore). During the first week, DGT were exposed and grab samples were collected with a high sampling frequency (night and day). Then, a second set of DGT were exposed during the second week. The resuspension of particles and anoxic sediment caused by fluvial traffic was highlighted by the simultaneous increase of metals and Hg concentrations (Cd, Pb, Zn, Cu, Ni, Pb, 0.3 to 34 mg/L). The analysis of metals and Hg in SPM showed increases of Pb, Zn, Hg and Cd concentrations in the particulate phase. The analysis of particulate Hg after two different filtrations at two cut-off points (0.45 and 0.70 µm) showed that particulate Hg re-suspended by fluvial traffic was mostly in the coarse fraction of SPM. Furthermore, the increase of SPM concentrations was related with an increase in dissolved Hg concentrations. These results suggest that when the anoxic sediment is remobilized by barge traffic, particles could be oxidized inducing a release of Hg. Moreover, since changes in redox conditions could also induce modifications in Hg speciation, further analysis will be carried out to measure Hg\(^{2+}\) and CHHg\(^{+}\).
Finally, the interpretation of DGT measurements will show how well DGT integrates variations of inorganic contaminants concentrations during the exposure period.

M0350
The effect of activated carbon amendment on mercury methylation in contaminated sediment
E. Sormo, G. Cornielsen, L. Silvani, E. Eek, Norwegian Geotechnical Institute: H. Veiteberg Braaten, NIVA / Norwegian Institute for Water Research; N.W. Johnson, University of Minnesota Duluth / Civil Engineering
The conversion of elemental and inorganic mercury (Hg) to monomethyl mercury (MeHg) has been widely studied due to MeHg being more bioavailable, bioaccumulative and toxic to humans than the inorganic and elemental species. The net production of MeHg is controlled by both mercury methylation and demethylation, and a range of factors affects both processes. Sediments are known sites for MeHg production, as they are sinks for Hg, they have suitable red-ox conditions, a presence of methylating bacteria and more. Activated carbon has been much explored as a remediation tool for contaminated sediments: The carbon can immobilize contaminants, inhibiting the release to the water column and uptake in biota. Studies have shown that activated carbon also sorb Hg-species, but the mechanisms of how a carbon amendment affects the processes of Hg-methylation in contaminated sediments is not well understood. A lab trial was set up with sediment from two sites in Norway: The Gunnhellefjord (GF) and Bergen Harbour (BH) – two heavily contaminated locations with long term usage of DGT measuring an aragonite gel and a spheruloid resin gel. Pore water data show a net production of MeHg in the GF control, from an initial 8.7 to 393 ng/l within the first month, but it then drops off to 147 and 18.4 ng/l after 3 and 6 months respectively. Compared to the control, an initial reduction of 86% MeHg in pore water is seen for the AC treatment, that increases to >95% for the 1, 3 and 6 month time series. The BH treatment caused an initial 55% reduction of MeHg, but after 1, 3 and 6 months the reduction is >99% compared to the control. In the BH sample, there was no increase of the initial 2.1 ng/l MeHg in the pore water of the control during the 6 months of the experiment. Both AC and BC treatments however, reduced MeHg in the pore water by >50%. Pore water MeHg-concentrations measured by DGT were similar to concentrations in extracted pore water, indicating that pore water MeHg is available for uptake.

M0351
Bayesian Human Health Risk Assessment of Almaden Mining Area
Almaden, with the largest and richest known mercury deposit is located in the northwest of Ciudad Real (Spain) with a population of 5,657 inhabitants (2016). This area can be considered one of the most affected by mercury in the world, both by its natural origin and by anthropogenic pollution since there are indications that the cinnabar mines of this region have been mined without interruption since before the fourth century BC until 2002. A probabilistic human health risk assessment has been carried out in order to establish whether mercury contamination of Almaden environment affects human health. The environmental contamination into the mine area was stopped on 15 August 2017. As Minamata Convention includes a ban on new mercury mines, and the phase-out of existing ones, this methodology could be used to establish if mercury contamination after mercury mines closure around the world endanger human health. E-mail contact: david.bolonco@upm.es, https://orcid.org/0000-0002-9166-1861

M0352
Concentrations of mercury in two offshore skates: sandy ray and shagreen ray
J.E. Nicolau, Cefas Lowestoft Laboratory / Environment and Ecosystems Mercury concentrations in muscle and liver tissues from two offshore species of skate were examined. Concentrations of mercury in muscle of Leucoraja circularis (n = 16, mean 10.5 cm total length, 157–490 m water depth) and L. squalina (n = 24; 28.5–100 cm total length, 130–426 m water depth) were 0.02–1.8 and 0.04–0.61 mg kg\(^{-1}\). Concentrations of Hg increased with total length. Only the largest specimen had a concentration of Hg in muscle >1.0 mg kg\(^{-1}\). Data were limited for specimens >90 cm long, and further studies on contaminants in larger-bodied skates could usefully be undertaken.

M0353
EMPIR project "MereOdX - Metrology for oxided mercury"
I. Fettig, Federal Environment Agency (Umweltbundesamt); M. Horvat, Jozef Stefan Institute; I. de Krom, VSL; D. Douglas, LGC; T. Rajamaki, VTT
Mercury (Hg) is one of the most toxic metals, and is regulated by the Industrial Emissions Directive (IED) 2010/75/EU, the Air Quality Directive 2004/107/EC, the Waste Incineration Directive 2000/76/EC and the Minamata Convention adopted in 2013: which is a global treaty to protect human health and the environment from the adverse effects of Hg. In addition to its elemental form Hg
also exists in oxidised forms (i.e. Hg(II)) that are reactive and can be transformed into organic Hg species such as methylmercury (MeHg), the most toxic Hg species and the one most prone to bioaccumulation in aquatic systems. Half of atmospheric Hg emissions are of natural origin whilst the rest are of anthropogenic sources, primarily from fossil fuel burning and other high temperature industrial processes (cement clinker production, waste incineration, ore roasting, steel production). Knowledge of Hg speciation both in air and in stack gas emissions is critical when validating models for predicting Hg emissions, transport, deposition and fate at the European level as well as on a global scale. Therefore, atmospheric Hg isotopic signatures that can be used to trace the origin and fate of atmospheric Hg also need metrological support and development. The overall goal of the EMPIR – MercOx project (Oct 17 – Sept 20) is to develop SI traceable measurements, for monitoring and control of mercury and its different species in gas emission sources and in the atmosphere. The project will achieve significant improvements in the measurement comparability and uncertainty of Hg measurement results. Currently, traceable calibration methods only exist for elemental mercury, but such measurements are also needed for oxidised Hg species in order to meet the requirements of EU regulation and the implementation of the Minamata Convention. The development of reliable and direct Hg(II) measurement techniques and reliable and traceable Hg(II) standards is needed to solve the traceability problem that currently exists in the measurement of total mercury (Hg(0)) and oxidised Hg concentrations originating from different Hg sources. Furthermore, methods for measuring oxidised Hg and for accurately comparing the Hg(II) concentration in generated elemental and oxidised Hg reference standards are required, as well as in situ/organ-specific burden of Hg(II) and mortality. A four-parameter Hill model was used for the on-line measurement of Hg under field conditions and a comparison of Hg species inter-conversion.

**MO354**

**PBTK/TD assessment of mercury (Hg(II)) accumulation in freshwater tilapia species**

C. Liao, National Taiwan University / Department of Bioenvironmenal Systems Engineering; W. Chen, Kaohsiung Medical University / Department of Biomedical Science and Environmental Biology; Y. Yang, National Taiwan University / Bioenvironmenal Systems Engineering

Waterborne and dietborne exposures of freshwater fish to inorganic mercury (Hg) affect their growth and reproduction. However, a mechanistic model to predict the impact of Hg(II) on freshwater fish is lacking. The purpose of this study is to develop a physiologically-based toxicokinetic/toxidynamic (PBTK/TD) model to assess bioaccumulation of Hg(II) in freshwater tilapia. A PBTK model consisted of six interested compartments can be constructed including blood, gill, liver, kidney, intestine and stomach. Then the choice of physiological and physicochemical parameters can be estimated from published tilapia-related studies. The partition coefficients were estimated for each tissue or organ based on the experimental data by dividing Hg burden in tissues of that in blood at specific days after Hg(II) exposure. A series of experimental data were analyzed to reconstruct the dose-response profiles describing the relationships between tissue/organ-specific burden of Hg(II) and mortality. A four-parameter Hill model was used to describe the dose-response relationships. Here we showed that tissue/organ burdens would reach equilibrium before 180 days of exposure in all six rivers. Among all exposed tissues/organs, kidney had the highest internal exposure doses of Hg(II) ranging from 0.0208 – 0.1348 µg g⁻¹ ww. In contrast, muscle had the lowest internal exposure doses of 0.0001 – 0.0003 µg g⁻¹ ww (HgII), indicating that Hg(II) would be well studied below body concentrations at risk for human consumption based on regulation from Taiwan FDA. The highest accumulative internal dose of Hg(II) was in gill of 0.0115 (95% CI: 0.0007 – 0.1907). The effective Hg(II) burden in tissue/organ at 50% mortality for liver, gill, and muscle were 10.410 ± 1.047, 6.307 ± 0.756, and 2.839 ± 0.575 µg g⁻¹ ww, respectively. A fair quantitative agreement between model predictions and experimental data was also reached. Sensitivity analysis indicated that the amount of Hg accumulated in tilapia whole body was most influenced by sediment uptake rate, indicating that sedimentborne Hg exposure was the most influential factor on accumulation of tilapia that is bottom-feeding fish. We suggest that more dose-response data of sublethal and chronic effects are required to improve future risk assessment in a mechanistic and practical way. In a broader way, our model can be applied to predict continuously chronic Hg accumulation in fish that are deemed safe for human consumption.

**MO355**

**Mercury in fish, fish intake and fish consumption recommendation**

H. Coelho Vieira, University of Aveiro / Department of Biology & CESAM; S. Abreu, University of Aveiro / Dep. Biology & CESAM

Fish consumption is recognized as an important component in the human diet, due to the high-quality protein content and n-3 fatty acids, however, it is also considered the main route of mercury (Hg) exposure from ingestion of contaminated seafood. Hg is released into the environment by natural and anthropogenic sources and is recognized as a pollutant of high importance, due its high degree of toxicity, persistence and bioaccumulative properties. Since exposure to mercury poses human health at risk, the Food and Agriculture Organization (FAO)/World Health Organization (WHO), Joint Expert Committee on Food Additives (JECFA) and also by the United States Environmental Protection Agency (USEPA) have been established reference doses (RfD) or “Provisional Tolerable Weekly Intake” (PTWI), in order to minimize that risks. JECFA established a PTWI for MeHg of 1.6 µg kg⁻¹ bw⁻¹ week⁻¹, whereas U.S. EPA took a lower value of MeHg intake, setting the RfD at 0.1 µg kg⁻¹ bw⁻¹ day⁻¹ (equivalent to 0.7 µg kg⁻¹ bw⁻¹ week⁻¹).

Recently (2012), PTWI suggested by JECFA for MeHg was revised by the European Food Safety Authority (EFSA) to 1.3 µg MeHg kg⁻¹ bw⁻¹ week⁻¹. This study, presents a brief review of the Hg concentration present in the muscle of commercially valuable fish species caught near the mid-Atlantic ridge (Azores Archipelago) where fish consumption relative high. (…) and compares these Hg concentration with the maximum levels of Hg for certain contaminants in foods. Freshwater tilapia was the most influential factor on accumulation of Hg(II) standards is needed to solve the traceability problem that currently exists in the measurement of total mercury (Hg(0)) and oxidised Hg concentrations originating from different Hg sources. Further, methods for measuring oxidised Hg and for accurately comparing the Hg(II) concentration in generated elemental and oxidised Hg reference standards are required, as well as in situ/organ-specific burden of Hg(II) and mortality. A four-parameter Hill model was used for the on-line measurement of Hg under field conditions and a comparison of Hg species inter-conversion.

**Mechanistic effect modelling for risk assessment: applications, use in a regulatory context and future directions (P)**

**MO356**

**Ring-test of different implementations of the General Unified Threshold Model of Survival (GUTS)**

R. Ashauer, University of York / Environment; T. Jager, DEBox Research / Dept of Theoretical Biology

The additional information and insight gained through the application of toxicokinetic-toxidynamic modelling can strengthen the environmental risk assessment of chemicals in consumer products or plant protection products. For the endpoint survival the most suitable and powerful tool is currently the General Unified Threshold model of Survival (GUTS), which consists of two complimentary models: GUTS-SD (stochastic death) and GUTS-IT (individual tolerance). In order to ease the use of GUTS and increase trust and acceptability we recently carried out a ring-test of eleven different implementations of GUTS. The frequency of erroneous results due to programming errors and less appropriate settings for numerical solvers or parameter search and convergence algorithms indicated that user training and experience is key. However after correction of user errors all software implementations resulted in comparable and similar results. Estimated parameter values generally agreed well and the implementations returned similar results in scenario tests. We conclude that new users and new GUTS implementations should be trained using this ring-test and refer to these results as benchmark. Any new user should run the ring test exercises and improve their modelling techniques until they achieve comparable results. Standardisation of typical use cases could also help to reduce sources of error as well as corresponding, user-friendly, robust GUTS software. This software could reduce sources of error by restricting user-choice to only those options suitable and relevant for the regulatory risk assessment under consideration.

**MO357**

**Feeding impairment in fish explained by a TK-TD model**

S. Augustine, Akwaplan-niva; A. Gergs, Bayer AG / Crop Science Division / Department of Environmental, Social and Spatial Change; K. Ladermann, Research Institute gaiac; E. Zimmer, IBACON GmbH; T. Reuss, Bayer AG / Environmental Safety; V. Ducrot, Bayer AG / Environmental Safety

Ecotoxicology

In current environmental risk assessment (ERA), plant protection products (PPPs) are tested on a diversity of standard test species for harmful effects. Recent developments in mechanistic effect modelling provide the possibility to extrapolate results from standard studies with test species to target species (e.g. fish) or th studies. Many compounds, especially those that target the nervous system, act on the ability of the organisms to feel or assimilate energy. Thus,
predicting effects on feeding and assimilation is a crucial characteristic for a TKTD model to predict sublethal effects in the context of ERA. We present here the results of the i-ERA project (integrated ERA) on the responses to low food conditions / feeding impairment in four fish species (rainbow trout, fathead minnow, zebrafish and medaka). We tested the DEB model for predicting organism level responses of juveniles (rainbow trout) and adults (all others) under low food conditions. We find that under low food conditions, fish do not change their basal metabolism compared to the standard DEB model. This indicates that the model can be used in ERA for the four fish species analyzed here to predict effects of compounds that act on feeding inhibition without any adaptation. The differences in the organism-level response to low food conditions / feeding impairment between the four species can be explained by differences in their model parameters. The standard DEB model can be extended to other fish species, for which low food conditions are not observed. This suggests that model adaptations needed in such case, and discuss how the model can be used in risk assessments for weight-of-evidence in tier-1 and tier-2 as suggested by EFSA.

**MO358**

**TK-TD modelling as additional line of evidence in the risk assessment for aquatic macrophytes: chlorotoluron as a case study**

J. Klein, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Ecotoxicology; U. Hommen, Fraunhofer IME; G. Weyman, ADAMA

To assess effects of the use of plant protection products based on chlorotoluron as active substance, various designs of laboratory tests with Lemna sp. and other species and also mesocosm studies including different macrophyte species are available. Since it is not possible to set up test scenarios exactly matching field exposure scenarios, TK-TD modelling was used as an additional approach to address the potential effects of short-term exposure as predicted for some FOCUS surface water scenarios. The Lemna TK-TD model developed by Schmitt et al. (2015) was used to simulate laboratory tests assuming exponential growth as observed in the experimental controls. Growth under field conditions was modelled as dependent on different growth factors, including light conditions. The substrate-specific TK-TD parameters were calibrated using the results of a growth inhibition test with 7 days of exposure followed by 7 days of recovery in fresh medium without test item. The so calibrated model was verified by comparing its predictions with results of three other tests with different exposure patterns, some of which were designed with this purpose in mind. Modelling parameters were close to or above 0.9 for all four tests and, thus, the model was considered suitable for simulating effects of different exposure patterns on the growth of Lemna. We simulated laboratory refined exposure tests with PEC profiles of the 7 days worst-case time window of the FOCUS step 3 scenarios as well as field populations using the full FOCUS profiles as inputs. For the exposure profiles characteristic of short-term pulses, margins of safety were above 10 to reach a 50 % inhibition of the growth rate over 7 days, the endpoint used in Tier 1. For the simulated field tests, maximum deviation of biomass under control and exposure conditions was used as assessment endpoint. If up to 25 % deviation of biomass of an exposed population from a control population is considered a negligible effect, the Margins of Safety was above 20 all analysed scenarios. The experimental results showed that the variation in marginal safety conditions are well understood. The exposure profiles considered here will, with a high probability, not lead to unacceptable effects on macrophytes. This project demonstrates the usefulness of modelling as additional tool in risk assessment of plant protection products, particularly for extrapolation between scenarios which cannot all be tested experimentally.

**MO359**

**TK/TD modelling as a tiered approach to reveal interspecies variability of toxicity in fish**

F. Gabisi, Rifcon GmbH; T. Preuss, Bayer / Environmental Safety

Species sensitivity distribution (SSD) analysis can be used in higher tier risk assessment to describe the variation in sensitivity of a group of species to a certain contaminant. Contrary to the standard procedure in which toxicity endpoints are derived by considering only effects at the end of a constant exposure experiment, this method has the potential to additionally make use of time-variable exposure and organism response over time. Here, changes in SSD (and the corresponding HC50) over time is compared for different species using the toxicokinetic/toxicodynamic (TK/TD) model for survival GUTS. The GUTS model was parameterized based on standard acute tests for each fish species and both stochastic death (GUTS-SD) and individual tolerance (GUTS-IT) assumptions were tested. Then, the 58-day LC50 for constant exposure and for two different pulse exposure scenarios (single and double pulses) were derived. The LC50 values were subsequently used as input for the SSD calculations. The SSDs were derived by fitting probability distributions to the LC50 data, and the corresponding HC50s were determined. The analysis was performed separately for two compounds. Results with both toxicons revealed that the sensitivity ranking for the fish species and consequently the HC50 values were not the same among the tested exposure scenarios. Predictions with either GUTS-SD or GUTS-IT models also had an impact on the SSDs and did not yield the same results for the same exposure profile. Additionally, longer exposure durations did not always result in lower HC50s. These findings infer that SSD strongly depends on the exposure scenario, and reveal the interference of substance toxicokinetics and organism responses to toxicity in determining the sensitivity ranking of the species. Therefore, it is essential for a reliable environmental risk assessment not only to consider realistic exposure scenarios, but also the TK/TD processes related to the substance and the organism. With a set of standard data, the GUTS model can help to achieve this goal for untested exposure patterns.

**MO360**

**RIFCON EasyGUTS: Ready-to-use and freely available software for TK/TD modelling of survival**

D. Nickisch, O. Jakobi, A. Medianev, Rifcon GmbH

GUTS (General Unified Threshold model of Survival) is one of the most commonly used models used for toxicokinetic and toxicodynamic evaluations of aquatic experiments in the context of the European registration of plant protection products at lower tiers in the ecotoxicological risk assessment. One user friendly implementation of this model is the Windows based program EasyGUTS. This implementation and its functionalities were recently tested and verified using published data. Results obtained with EasyGUTS are in good agreement with results obtained from various other publications and model implementations. However, one limitation of the program during this verification process was that it was only possible to select the log-normal distribution for the individual tolerance model rather than giving the possibility to also use other functions like a log-logistic distribution. This was the case since the GUTS R package to which EasyGUTS is linked, is restricted to only this possibility. Since a TK/TD draft guideline is expected earliest next year and no preference for a distribution is given in recent publications, in line with the EFSA ‘Scientific Opinion on Good Modeling Practice’. Moreover, EasyGUTS as a functional tool was tested in internal and external model workshops. Our experience is that the usability of the software and the robustness of the calibration algorithm was fitting well, so that even all users could reproduce results and decisions. Since EasyGUTS is finally verified and harmonised with the R GUTS package, it is ready to use under free license agreement and can be downloaded from the RIFCON homepage beginning of 2018. This poster presents the implementation of EasyGUTS and gives insight on the sensitivity of the model to initial parameter values and the influence of different distributions used for the individual tolerance model.

**MO361**

**A new test design to inform TKTD models on species sensitivity**

E. Brems, Bayer AG; Division Bayer CropScience / Ecotoxicology; K. Kuhl, Bayer AG - CropScience Division; J. Hager, Bayer AG; T. Preuss, Bayer AG / Environmental Safety

Recently, several TK/TD population modelling approaches have been developed and are applied in different risk assessment areas. The European Food Safety Authority (EFSA) guidance on tiered risk assessment for plant protection products for aquatic organisms in edge-of-field surface waters support the use of GUTS modelling as an approach for the aquatic risk assessment for the evaluation of time variable exposure. For aquatic invertebrates two key questions exists for the ecological threshold option. 1) What is the species sensitivity distribution 2) What are the effects from short-term / peak exposure patterns on long-term survival and reproduction. Currently TK/TD models are parameterised on the standard Tier 1 or Tier 2 species. Particularly exposure patterns, test conditions and exposure duration need to be specified. Exposure over long time periods (week to months), which makes these experiments costly, time consuming and which limits the number of non-standard species to be investigated, as these species - in the absence of appropriate husbandry and test methods and due to complex biologies - are particularly challenging to test reproducibly in chronic set-up’s. Here we will present an approach using the GUTS model (TK/TD model for survival) informed by specifically designed peak-exposure experiments to answer both questions. We will employ short-term experiments, lasting 48h with two short peaks of 4h duration, at 3 different treatment levels of an insecticide, in combination with several observation time points for 5 aquatic insect species and 3 crustaceans. The outcome of these experiments will inform the GUTS model and will allow for a suitable calibration, after which it will then be possible to construct pattern-specific species sensitivity distributions to be used in acute effect assessments for time variable exposure patterns like FOCUS scenarios. Moreover, the approach may also provide further insights whether peak exposure experiments in an acute study design can be used to investigate sensitivity differences also on a longer-term time scale, by concurrently preventing the pitfalls and potential artefacts arising from not yet developed, adequate long-term husbandry- and test protocols for non-standard species.

**MO362**

**Impact of temperature on species sensitivity distribution in aquatic invertebrates**

K. Lademann, S. Classen, Research Institute gaiac; T. Strauss, M. Hammers-Wirtz, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; A. Gergs, Bayer AG - Crop Science Division / Department of Environmental, Social and Spatial Change
Aquatic effect assessment uses results from laboratory experiments at constant environmental conditions. However, for these tests organisms are kept under optimal temperatures which might differ across species. If done for multiple species, results from these toxicity test are used to statistically derive community level endpoints, such as the HC5, from species sensitivity distributions (SSDs). Therefore, data from acute toxicity tests are ranked using cumulative distribution. Applicability of toxicity endpoints, such as the LC50s, have been reported to depend on ambient temperature, which is in accordance with aquatic invertebrates and fish species. If comparing species sensitivity the results might be biased by the experimental conditions. It has been demonstrated that changes in physiological rates with different temperature regimes can be described by the Arrhenius function. Part of this study is to examine if the Arrhenius function is also able to predict TKTD model rates, and to compare different temperature regimes. Use GUTS to extrapolate toxic effects across temperatures and investigate the impact of temperature on a species sensitivity distribution (SSD) with aquatic invertebrates regarding Chlophytis.

MO365
The use of population models in copper risk assessment: a case study with Acipenser transmontanus
K. Vlaeminck, Arche consulting / GhEnToxLab; K. Vlaeminck, Ghent University / GhEnToxLab; P. Van Sprang, ARCHE; K. De Schampheleere, Ghent University (UGent) / Applied Ecology and Environmental Biology

Current metal risk assessment consists of assessing single-species data on metal toxicokinetic and toxicodynamic (TKT) endpoints and constructing a species sensitivity distribution (SSD) for the derivation of safe thresholds. Despite their usefulness, SSDs have been criticized over the last decades for being ecologically unrealistic, and for typically only accounting for individual-level endpoints. Population models as an alternative are becoming more popular in ecotoxicology as they translate a pollutant’s effect on individuals (e.g. survival) to the population level (e.g. growth rate). Additionally, ecological models are less expensive and time-consuming to develop and perform research with compared to population experiments. In this study, we aimed at adapting an existing white sturgeon (Acipenser transmontanus) population model to predict population level effects of copper toxicity. The white sturgeon is a fish species particularly sensitive to copper during early developmental life stages. An individual-based model (IBM) was implemented using the software platform NetLogo. Copper effects were integrated by adjusting the mortality rate for the sensitive life stage (age 0-individuals) for different scenarios (i.e. environmental configurations, exposure profiles, etc.) population-level effects were assessed as a function of the copper concentration. As expected, population equilibrium density decreased with increasing copper concentrations. Effect concentrations (EC50) for population equilibrium density were situated in the same range as (traditional) lethal concentrations (LC50, values) at the individual level. Nonetheless, the magnitude of the population’s response to copper depends on several environmental factors such as habitat fragmentation and distribution of the pollution in the river system (random, heterogeneous, or homogeneous). Population EC50 values were derived with the IBM by extrapolating observed (conventional) LC50 values from literature. Here we adapted the population model for A. transmontanus to include some inherent assumptions which need further fine-tuning. By investigating the mortality profile (i.e. mortality over time) in depth, the mortality sub-model could be improved further, increasing predictability of the model. Additionally, investigating population density-dependent effects on the survival of age 0-individuals could increase accuracy as well. This study shows that population models could be used as more ecologically-relevant tools in metal risk assessment.

MO366
Comparison of toxic effects on Daphnia magna between a metal, a pesticide, and a PAH, in a toxicokinetic-toxicodynamic framework
K. Vlaeminck, Arche consulting / GhEnToxLab; K. Vlaeminck, Ghent University / GhEnToxLab; P. Van Sprang, ARCHE; K. De Schampheleere, Ghent University (UGent) / Applied Ecology and Environmental Biology

Modeling techniques are becoming more prominent in the risk assessment of chemicals. Mechanistic models, such as individual-based models (IBM) with a foundation in the dynamic energy budget (DEB) theory, are increasingly promoted as alternative tools in ecological risk assessment. In this context, lethal toxicokinetic-toxicodynamic (TKTD) models are often used to describe (sub-)lethal effects on the life cycle of the modelled organism. Inherently, the mode of action will differ between compounds (i.e. compounds will affect different physiological processes). The current study compares TKTD parameters of three different compounds, and examines their influence on the dynamic energy budget (DEB) of the aquatic species Daphnia magna. A TKTD model is made between three model substances: a heavy metal (Cu), a pesticide (endosulfan), and a PAH, in a toxicokinetic-toxicodynamic (TKTD) framework. All models were compared to lunch experiments. Using all three endpoints, the modes of actions and the TKTD parameters were estimated for copper, endosulfan, and pyrene. Combining the TKTD model with DEB-IBM, effects on physiological processes can be translated to the organism level.

MO367
Decreasing predicted no-effect concentrations for perfluoralkyl acids in the Po river ecosystem through a novel methodology based on the AQUATOX ecosystem model
A. Gredelli, A. Barausse, L. Grechi, L. Palmeri, University of Padua / Department of Industrial Engineering

Health and environmental risks posed by perfluoralkyl acids (PFAs) have been a subject of debate especially in water supply systems and for urban areas. One of those is the Northern Italy, because of its high industrialization and population. Nevertheless, the real risk connected to PFAs as emerging contaminants, both for ecosystems and for human health, is still somewhat unexplored. Linking external exposure to the effective dose of the chemical is one of the main tasks of Environmental Risk Assessment procedures. The establishment of safe ecological thresholds such as Predicted No-Effect Concentration (PNEC), based on procedures incorporated in the REACH regulation and Water Framework Directive and in related guidelines. These policies offer three methodologies for deriving PNEC: use of assessment factors (AF), species...
sensitivity distribution (SSD), and results from model ecosystems and field studies whose task is to extrapolate single-species data to ecosystem-level responses. Although AF and SSD methods are described by strict guidelines making them commonly applied, they do not consider the effects of ecological interactions between species on the assessed risk level, which is potentially not-negligible since population dynamics in polluted environment are not only driven by direct toxicity of chemicals on single species. One cost-effective alternative for assessing the ecological risk of chemicals, considering also indirect ecological effects is the use of mechanistic ecosystem models, simulating the multiple interactions between biotic and abiotic ecosystem compartments. However, there is lack of official guidance for models choice, development and use, resulting in scarce implementation of ecological models for regulatory purposes. Accordingly, two main goals of this work were to test a new approach for deriving PNEC by use of the US-EPA AQUATOX ecosystem model, and to evaluate the risk posed by PFAAs (represented by two long-chained and two short-chained compounds) in the ecosystem of the Po, the greatest river in the Northern Italy. Through AQUATOX, water concentrations of PFAAs resulting in a non-negligible biomass loss for each modelled population of the ecosystem were assessed, thus connecting biomass density (a model output) to a “safe” concentration (PNEC). The resulting PNECs were compared to PNECs derived with conventionally used AF and SSD methods to assess the performance of the proposed novel methodology.

MO368
Incorporating spatially explicit metapopulation models as the endpoint of an Adverse Outcome Pathway-based Bayesian Network-Relative Risk Model
J.D. Stark, Washington State University / Dept of Entomology; C. Mitchell, Washington State University / School of the Environment; V. Chua, Western Washington University / Environmental Science; M.E. Harris, Western Washington University; L. Wallis, Western Washington University / Institute of Environmental Toxicology; G. Young, Advising WorleyParsons Group / Aquatic Sciences; W.G. Landis, Western Washington University / Institute of Environmental Toxicology; K. von Stackeberg, NEK Associates LTD / Department of Environmental Health
Population viability analysis is useful tool for assessing the environmental risk of toxicants because it produces endpoints relevant to managers and can be manipulated to compare the potential outcomes of conservation actions. In general, many Environmental Risk Assessments (ERAs) lack utility and realism because they fail to incorporate the combined effects of lethal and multiple sub-lethal impacts, environmental stressors, and chemical mixtures into a relevant endpoint for managers. To improve the utility of regional scale risk assessment, we are developing a Bayesian Network-Relative Risk Model that incorporates the combined effects of toxicants and environmental stressors into an Adverse Outcome Pathway (AOP) framework linking environmental conditions to spatially explicit metapopulation models. As a primary case study for this new model, we are examining the impacts of organophosphate (OP) insecticides on ESA-listed chinook (Oncorhynchus tshawytscha) and coho (Oncorhynchus kisutch) salmon populations using site specific data from the Lower Skagit, Nooksack, Cedar, and Yakima River watersheds in Washington State. The AOP within the BN-BRM links concentrations of OPs to > 10 Acetylationlinesterase (AChE) inhibition which is then linked to sublethal impacts that are incorporated into matrix metapopulation models through age-specific reductions in survival and reproduction. The outcome of this effort will be an adaptable management tool that uses existing, disparate data to link realistic toxicant concentrations to probabilistic population outcomes. The preliminary results from this model development suggest that environmentally realistic concentrations of OPs may slow the growth of salmon populations, undermining the success of current restoration efforts.

MO369
Modeling and monitoring the effects on the central nervous system of a chronic exposure to low dose of pollutants: an innovative strategy with first results
T. Claudepierre, URAFPA INRA / URAFPA INRA; F. Desor, C. Cakir Kieffer, Université de Lorraine UL / URAFPA INRA; M. Delannoy, URAFPA INRA / URAFPA INRA; A. El Haji, T. Oster, C. Malaplate, Université de Lorraine UL / URAFPA INRA; N. Tran, Université de Lorraine UL / École de chirurgie, Faculté de Médecine de Nancy; F. Yen-Potin, C. Feidi, Université de Lorraine UL / URAFPA INRA
Chronic low dose exposure and possible cumulative effects of various pollutants can affect consumer health and may contribute to the development of neurodegenerative pathologies. Due to the highly complex and long exposure, a clear cause-effect relationship between pollutants and neurodegenerative diseases has often been suspected, but rarely proven. An additional drawback is the high diversity of in vitro models (cancer cell lines, stem cells, primary embryonic cells), bringing additional complexity in the deciphering of the observed effects of pollutants. To properly assess the risks and to reevaluate the maximal acceptable dose of specific pollutants in the food chain, there is a need for efficient modeling of pollutant effects on the central nervous system (CNS). To address this need, we are developing a new approach to evaluate the consequences on neuronal health of long time exposure to pollutants. We are actually re-evaluating the neurotoxic effects of chlordecone (CLD) as proof-of-concept of our strategy. Several concentrations of CLD were used to treat a variety of mouse primary neurons isolated from different postnatal CNS areas. We then assessed neuronal functions using specific markers for neuronal death, neurite development and synapse formation. In parallel, we produced cerebrospinal fluid (CSF) from pigs exposed to CLD via contaminated food. This CSF containing CLD and its by-products that are able to cross the blood brain barrier could then be used on the same cultures to compare its effect with that of the pure compound. We are following direct treatment with the molecule. We were able to identify a direct neurotoxic effect (10 µM) on specific purified neuronal cultures together with more subtle damages at lower concentrations including neurite arborization defects (0.1 to 1µM depending on the respective neuronal cultures). Additional effects on pure glia cell cultures at higher concentrations (100 µM) suggest a reactive gliosis in the whole animal. These observations were confirmed by CSF treatment using CLD-contaminated CSF but not with CSF from control pigs. In addition, the dose with no observable effects is at least 10 times lower using primary postnatal neuronal cultures compared to embryonic cultures. Our experimental model is therefore much more sensitive and may reflect more precisely the consequences of chronic CLD exposure. Our strategy could help to re-evaluate the CNS effects of this remnant pollutant present in West Indies soils.

MO370
A new classification method for mechanisms of toxic action
F. Bauer, KREATIS; P.C. Thomas, CEHTRA SAS / Ecotoxicology and Risk Assessment
A knowledge of the mechanism of action (MechoA) of substances is a crucial first step in risk assessment approaches, especially when using in silico models to predict (eco)toxicity. Mechanisms of Action are similar to Molecular initiating Events which govern molecular interactions between xenobiotics and biological material. Using the accumulated knowledge of MechaoAs covering hundreds of molecules, we developed a set of structural alerts associated with specific MechaoAs. Consequently, a new method to predict MechaoAs with high accuracy and with simple rules was developed, using aMechaoA classification with 6 general MechaoAs including 23 detailed MechaoAs. The MechaoAs are given mainly for mammals and fish but information on other species was also included. We used a training set of 301 molecules, and validation set of 491 molecules. Our method was built as a linear decision tree composed of 62 decision rules. This method achieved 92.0% correct classifications for the training set and 92.3% for the validation set. 6% of the predicted classifications were slightly different from the literature MechaoAs for the training set (3.4% for the validation set) and 1% of the training set was misclassified (4.3% in the validation set). Finally, only 1% was out of the applicability domain for the training set while no molecules from the validation set were unclassified. This model is both simpler and performs better than the previous one which was developed (Bauer et al. 2018). We compared this method with Verhaar (as updated in 2008) (Verhaar et al., 1992, 2000, Enoch et al., 2008) and Russom (MOA classification by OASIS implemented in OECD QSAR Toolbox) (Russom et al., 1997) methods, and our decision tree showed the best statistics. This method is currently being implemented into a software, and it will be made freely available and we consider it as a useful support in risk assessment. This model will be constantly enhanced with the addition of new rules and minor corrections as needed.

Biocides and Veterinary Medicines: latest developments in regulatory risk assessment, research and monitoring (P)

MO371
Biocide leaching from building facades: Pseudo-persistence in soil due to reoccurring emissions
U. Bollmann, Aarhus University / Environmental Science; D. Fernández-Calviño, K.K. Bräntl, University of Copenhagen / Department of Plant and Environmental Sciences; M.S. Storgaard, Aarhus University, Department of Environmental Science / Department of Environmental Science; H. Sanderson, K. Bester, Aarhus University / Environmental Science
Facade paints and render are commonly protected against biological deterioration using biocides. Mixtures of in-can as well as film preserving bactericides, algaecides and fungicides are added to the materials. Nevertheless, active ingredients leach from the treated facades, if contacted with wind-driven rain. Especially in suburban residential areas a large fraction drains directly to soil, e.g., flowerbeds, gravel strips or the lawns surrounding the houses. Consequently, the soil in areas with biocide-treated buildings is exposed to rain runoff water highly polluted with biocides. In the present study, the degradation rates of eleven biocides in soil were determined in laboratory microcosms. Degradation half-lives ranged from rapidly degrading ($T_{1/2} < 10$ d) to compounds with higher persistence ($T_{1/2} > 120$ d). For two selected biocides (terbutryn and octylisothiazoline) a set of transformation products were quantified in the microcosms as well. This showed that the mass balance for terbutryn could be closed with nine analysed transformation products for the entire incubation period (120 d), revealing that relative persistent metabolites are formed. In contrary, the mass balance including non-transported compounds, of octylisothiazoline was not closed, as transformation products were degraded as well. However, Microtox tests revealed reduced toxicity of transformation products towards Aliivibrio fischeri than the
respectively parent compounds. Nevertheless, for most biocides the degradation half-life is longer than time intervals between rain events in Northern Europe. Hence, though many of the used biocides are degrading relatively rapidly in soil most of the compounds residues may accumulate in soil surrounding biocide treated buildings, due to repeated input with every driving-rain event. Consequently, most biocides can be considered as "pseudo-persistent"-contaminants in this context. This was verified within the present study by subsurface soil screening, where concentrations of up to 0.1 μg g⁻¹ were detected for parent compounds as well as terbutryn degradation products in soils below biocide treated facades.

**MO372**

**Biocides in facade coatings: Influence of pigments on the phototransformation of biocides**

M.M. Urbanczyk, Aarhus University (AU) / Department of Environmental Science (ENVS); U. Bollmann, Aarhus University / Environmental Science; N. Borth, Dr. Robert-Murjahn-Institut; U. Schoknecht, BAM Federal Institute for Materials Research and Testing; K. Bester, Aarhus University / Environmental Science

Biocides are common additives in facade coatings to protect the materials against biological deterioration. In-can as well as film preservatives are used for this purpose. Nevertheless, these biocides leach to the environment when the facade is getting in contact with driving-rain. Long-term exposure tests in natural weather showed large gaps in the mass balances, indicating towards other loss mechanisms. The present study focused on phototransformation as a major pathway for active ingredient loss. In laboratory experiments in UV-weather chambers the formation and fate of biocides and end-products were examined. For the latter, a subcategorisation according to the European Emission Scenario Documents (ESD) providing methods for release estimation of active substances was used. A new and advanced emission scenario was developed in case of application of disinfectants. The 'risk envelop' to demonstrate safe use for all products may become burdensome. Hence, this work will give guidance for a strategy to reduce workload for biocidal product families (BPFs), which consist of products with the same active substances, similar compositions within specified variations and代谢ly subdivided into subfamilies called 'categories'. Additionally, for a complete environmental risk assessment different life cycle steps of the biocidal end-product have to be assessed. Consequently, the incorporation of the in-can preservative into the end-product (formulation) as well as the end-of-life (application and service life) within a subcategory have to be considered. To reduce the workload and to prioritize the emission estimation it was decided to define emission scenarios which describe a realistic worst-case situation for the environment refer to application amount, emission days and release fractions. The basis of expert knowledge, draft competent authority reports of in-can preservatives and a survey between stakeholders, industry and other EU member states worst-case scenarios were identified and discussed at EU level. Finally, the revised ESD suggest one or a few worst-case scenarios for some pigments. Using a prioritisation concept for pigments a worst-case scenarios, calculation sheets for the estimation of the emission from other uses are provided as Appendices, so that the emission from other end-products (non-worst-case scenarios) can be calculated as well, by using this ESD.

**MO375**

**Monitoring of Biocides in German Sewage Treatment Plant Effluents - First Results**

C. Meier, German Environment Agency (UBA) / Biocides; K. Pohl, German Environment Agency (UBA) / Section Biocides; M. Ahling, I. Noeh, German Environment Agency UBA / Biocides; A. Thoma, F. Sacher, DGVO Water Technology Center; M. Kaiser, S. Fuchs, Karlsruhe Institute of Technology KIT / IWG

Due to a widespread use, biocidal active substances and their transformation products are expected to be found in the environment. Projections show that there will be an increase of biocide entries in the environment, mainly in urban areas due to an increased use of e. g. disinfectants and especially masonry preservatives. Biocidal substances enter the environment through numerous entry pathways. One main entry path is through sewage treatment plants (STP). Therefore, the German Environment Agency (UBA) initiated a project where the effluent of 29 public STPs from all over Germany will be investigated over a period of one year, starting in November 2017. Additionally, selected samples from influents as well as from sewage sludge emissions will be in the focus. Using a prioritisation concept for biocides a list, ranking substances that enter the environment through the STP-pathway, was generated. The list was judged by experts and finally, for this project 23 biocidal active substances or transformation products were chosen for analysis. First results show that several substances can be detected at measurable concentrations in the effluents. This ongoing project will provide better knowledge about the fate and behaviour of biocides entering the environment through sewage STPs. It will give us a time dependent picture of the environmental pollution by biocides in Germany through urban STPs and will also show possible fields of action for regulatory purposes.

**MO376**

The 'risk envelope approach' applied to environmental risk assessments for disinfectants - a strategy to reduce workload for biocidal product families

A. Vanden Bosch, ARCHE; L. Jansen, Arche consulting; S. Navis, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; E. Van Ael, A. Ghekere, Arche consulting; F. Verdonck, ARCHE; T. De Wilde, Arche consulting

K. Michaels, German Environment Agency (UBA); M. Schwander, German Environment Agency Umweltbundesamt; M. Galler, M. Schweitzer, SCC GmbH

Preservatives for products during storage are also known as in-can preservatives and are regulated according to Regulation (EU) No 528/2012 (BPR). These preservatives are biocidal products which are used in many different end-products (e.g. detergents, paints, glues etc.) to prolong their service life. The environmental emission of these end-products is evaluated in the European Emission Scenarios Document (ESD), whereas the existing ESD for in-can preservatives does not contain calculations for the variety of all end-products. Consequently, the German Environment Agency (UBA) initiated a research and development project for the further development of the evaluation method of in-can preservatives. The draft for the revised ESD has been prepared by SCC GmbH on behalf of the German UBA. Due to the variety of different applications of in-can preservatives, a differentiation was made in 6 sub-categories. Additionally, for a complete environmental emission estimation different life cycle steps of the biocidal end-product have to be assessed. Consequently, the incorporation of the in-can preservative into the end-product (formulation) as well as the end-of-life (application and service life) within a subcategory have to be considered. To reduce the workload and to prioritize the estimation it was decided to define emission scenarios which describe a realistic worst-case situation for the environment refer to application amount, emission days and release fractions. In the basis of expert knowledge, draft competent authority reports of in-can preservatives and a survey between stakeholders, industry and other EU member states worst-case scenarios were identified and discussed at EU level. Finally, the revised ESD suggest one or a few worst-case scenarios for some pigments. Using a prioritisation concept for pigments a worst-case scenarios, calculation sheets for the estimation of the emission from other uses are provided as Appendices, so that the emission from other end-products (non-worst-case scenarios) can be calculated as well, by using this ESD.
plant protection product dossiers. It entails - that for each area of risk assessment - the key parameters driving that risk assessment are identified. Subsequently, the uses are grouped and ranked according to these key parameters. As such, one or more worst case or 'critical' uses can be identified. If it can be demonstrated that there is no undue risk to men or environment for the critical use, all other uses are considered to be covered as well. A case study will be presented whereby the concept of the risk envelope is applied to the environmental risk assessment for a BPP of disinfectants (PT 1-5). Risk assessments can be grouped (a) for different products/uses within a meta SPC, and (b) for different products/uses across meta SPCs. Overall, applying the risk envelope approach may lead to a great reduction in workload, whilst allowing for easy addition of products/uses to the BPP at a later stage. The benefits and potential difficulties of this approach will be discussed in detail.

MO371

Hazard evaluation of biocides and its metabolites for the aquatic compartment

D. Hernandez-Moreno, INIA / Environment; M. Blazquez, INKOA SISTEMAS / RTD; O. Andreu-Sánchez, Xenobiotics; A. Bermejo-Nogales, M. Fernandez-Cruz, INIA - National Institute for Agricultural and Food Research and Technology / Environment

The EU-ECOMBASE project main target is to promote the sustainable use of biocidal active substances by developing prediction models. As a first step, a database compiling aquatic toxicity data to the aquatic compartment for biocides and derived metabolites has been implemented. The aim of the present study is to make a critical review of this information in order to have a wide view about their potential risk for the aquatic compartment. All the biocides approved and under review were compiled (277 active substances; Regulation (EU) 528/2012). A selection of 192 biocides with possibilities to be modeled and a search using several official and scientific databases, looking for any possible metabolite derived from their release in the aquatic compartment were done. Data was collected in an excel file, including identification of the biocide or metabolite (EC NR, CAS NR, SMILES), classification data (main group, product type, regulatory status), LogP, hazard classification, ecotoxicological data, and acute toxicity data for fish, invertebrates, algae and WWTP microorganisms. The EU Regulation (EC) No 1272/2008 on classification and labeling was considered to group these compounds in four toxicity categories taking into account the values of NOEC or LC50 as: 1 (≤ 1 mg/L), 2 (>1 to ≤ 10 mg/L), 3 (>10 to ≤ 100 mg/L) and 4 (>100 mg/L). Most of the found data was related to toxicity in fish, followed by invertebrates and algae, main databases being the least studied. There was not reported data for around 18% of the 185 metabolites found, probably due to, in some cases, their commercial unavailability. Another identified problem was that some data were developed with formulated products or with active substances for which purity was not reported. Data already analyzed for the acute toxicity indicated that, 62% of the biocides were located in category 1 for invertebrates, 54 % for fish and 52% for algae. Only 2% of biocides belong to this category for the microorganisms group. Metabolites are mainly less toxic than the parent biocides, however many of them present the same toxicity and very few (< 7%) are more toxic. The ongoing work indicates that biocides and a considerable percentage of their metabolites present a high toxicity for the aquatic species. It also identifies data gaps related to the ecotoxicological potential for metabolites. Acknowledgements: LIFE-COMBASE project (LIFE15 ENV/E/000416).

MO380

Synchronous decreasing levels of imposex and tributyltin (TBT) in dogwhell (Nucella lapillus) from Norway, 1991-2015


Imposex is TBT-induced feminizing of male sea-shells in the marine species Nucella lapillus. This biological effect is quantified by the Van DeFurman Sequence Index (VDSI). Levels of imposex and TBT in N. lapillus have been monitored annually in Norway since 1991. Populations around the North Sea were critical reduced in the 1990s, due to increased use of TBT-based antifouling paints. Before the global TBT-ban in 2008, increased TBT-levels coincided with increased imposex prevalence at many monitoring sites located close to high maritime activity. After 2008, decreasing TBT-trends at former impacted sites, lead to population recovery of N. lapillus. The observations in N. lapillus further corroborated by monitoring data showing decreased TBT levels in blue mussel (Mytilus spp.). This monitoring data confirm the rationale of implementing strict antimicrobial regulations on industrial chemicals when this can be linked to ecological perturbations in coastal ecosystems. The TBT/imposex monitoring was conducted at eight coastal stations representing the Norwegian coast from the Oslofjord to the Varangerfjord, following the guidelines given by OSPAR and ICES. Subsequently, 50 specimens from each station was analysed individually for imposex/VDSI and pooled (only females) for TBT and other organolit like THTT (Tributyltin). The TBT levels in VDSI in TBT (≤ 1 mg/kg w.w.) were low in N. lapillus at eight stations in 2015. At most stations, VDSI was 0 or close to 0 and below the OSPARs Background Assessment Criteria (BAC=0,3). The highest level (VDSI=0.828) was found at the shipping channel Karmunsund, which were above BAC but below the OSPARs Ecotoxicological Assessment Criteria (EAC=2). There were significant downward long-term (whole period 1991-2015) and short-term (recent 10 years 2006-2015) trends for both imposex/VDSI and TBT based on time trend analysis. These results show that the Norwegian legislation banning use of TBT on boats less than 25 m in 1990, on larger ships internationally from 2003, and the total ban in 2008 have been effective
in reducing imposex in *L. littorina* and have re-established some of the populations. Low levels or significant downward long-term and short-term trends for TBT in common periwinkle (*Littorina littorea*) and blue mussel (*Mytilus spp.*) substantiate this.

**MO381**

**Risk assessment issues for algaecides under BPR**

C. Durou, M. Darriet, J. Rivera, CEHTRA SAS

A prospective and comprehensive environmental risk assessment (ERA) must be performed on the active substance for the market authorisation of biocidal products. The technical guidelines are made publicly available by ECHA. The data required for the ERA include the determination of a set of properties (physical-chemical, fate properties, short-term and long-term ecotoxicity), an effective in-use dose or concentration, frequency of application of the biocidal product etc. . . In coming years, a prospective risk assessment has to be prepared in order to address the risk associated with the use of biocidal containing these active substances and also any substance of concern. The initial approach for a prospective environmental risk assessment will proceed with a Tier 1 calculation, which assumes 100% of the applied chemical will be released and ignores the formation of degradation products neither biodegradation of the active substance, neither consumption of active substance due to its biocide activity. These initial assumptions may lead to an overestimation of the environmental exposure and risks to the active substance. The initial environmental risk assessment can be refined with supporting data e.g. on the degradation and/or dissipation of the active substance and also by consideration of risk refinement realistic worst cases to more accurately assessing the leading hazard. In the case of biocidal products applied in swimming pools to disinfect or to control algae growth in water, several actives substances are under evaluation or are recently approved in the EU which includes halogenated compounds, inorganic compounds, quaternary ammonium compounds. The present work focuses on the application of the Biocide risk assessment methodology to algaecide applied in swimming pools. The poster will focus on following key aspects: to determine an effective in-use concentration which is an input parameter for assessing the risks associated with the active substance to define the ecotoxicological dataset which is needed in order to determine accurate PNEC values for characterising the risks posed by the active substance to discuss possible options to refine the exposure of environmental including new studies and risk management measures.

**MO382**

**Could a spatially distributed modelling approach enhance post approval considerations for veterinary medicines?**


Within the post-approval assessment framework developed in Europe for veterinary medicines, only 42 are measured, and in total 23 substances actually detected. These detected involved 15 antibiotics, four anti-parasitic resources, three anthelmintics and one poison killer. Our quick-scan confirms that a good insight into the presence of veterinary medicines in the water cycle is still lacking. Not only measurement data is limited, it became clear that data on local and regional surface waters is missing or fragmented. We propose inclusion of monitoring data in national and international databases, so this becomes available for other purposes, including prioritization. We also see that current monitoring schemes is not specifically aimed at veterinary medicines, and due to the fact that emissions, temporal and spatial trends, emission routes and concentrations at relevant locations are little available, no clear overview of risks is yet existing. Further noted that the origin of a detected compound cannot always be properly traced back to the original non-veterinary use only. We note that non-veterinary compounds are also used in human medicines or as pesticides. Admission to the market, based on active substances, is therefore sometimes regulated in different rulemaking and also, usage data is scattered. This makes priority setting difficult when performed in a segregated view on the universe of chemicals.

**MO383**

**Are currently-adopted European guidelines on veterinary medicine product and feed additive risk assessment sufficiently cautionary?**

A. Di Giardina, Universita degli Studi di Milano-Bicocca / Department of Earth and Environmental Sciences; B. Kolar, National Laboratory of Health, Environment and Food; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences

Veterinary medicine products (VMPs) are used in livestock production to preserve animal health or to promote growth in certain categories of animals; feed additives (FAs) are products aimed at improving the quality of feed and the quality of food from animal origin, or to improve the animals’ performance and health. These substances may not be put on the market unless authorisation has been given following a scientific evaluation demonstrating that they have no harmful effects, on human and animal health and on the environment. In particular, according to European Framework Directive 2001/82/EC, the environmental risk assessment (ERA) procedures for VMPs are based on technical guidance documents which propose a tiered approach to calculate PECsoil and PECgw of VMPs from livestock manure spread on the field. On the same way, the ERA procedure for feed additives is reported in a technical guidance document from EFSA which describe a two-tiered approach to calculate PECsoil and PECgw from spread manures. Calculation of PECsoil proposed by the two ERAs in the first tier is directly related to the “annual nitrogen (N) immission standard” which is the amount of nitrogen per Hectare spread on or into the field. Both ERAs propose a default value of 170 kgN Ha⁻¹ which is the maximum allowed annual amount of nitrogen originating from animal manure on a farm within nitrate vulnerable zones (NVZ). On the other side, in Europe, NVZs are measured, and in total 23 substances actually detected in several zones higher thresholds of N immission standard are allowed. Both ERAs procedures could therefore underestimate the PECsoil with a potential environmental toxicity for non-target terrestrial organisms. This study is aimed to evaluate if PECsoil, calculated using standard models currently used in the authorization procedures of VMPs and FAs, are sufficiently adequate to protect soil and groundwater. In particular, we focus on three active substance to discuss possible options to refine the exposure of environment including new studies and risk management measures.

**MO384**

**Quick scan to monitoring data of veterinary pharmaceuticals in the Netherlands**

S. Kools, T. ter Laak, KWR Watercycle Research Institute

On the Dutch market, approx. 260 active substances are used in different veterinary medicines. In a quick scan, we investigated the potential contribution of veterinary medicines to other contaminants to water quality, e.g. to drinking water supplies. The bulk of the compounds on the market are not measured in water, as these sources are related to drinking water production. From the bulk of the compounds on the market no measurement data are known (84%). Of the 260 compounds used in veterinary medicines, only 52 are measured, and in total 23 substances actually detected. These detected involved 15 antibiotics, four anti-parasitic resources, three anthelmintics and one poison killer. Our quick-scan confirms that a good insight into the presence of veterinary medicines in the water cycle is still lacking. Not only measurement data is limited, it became clear that data on local and regional surface waters is missing or fragmented. We propose inclusion of monitoring data in national and international databases, so this becomes available for other purposes, including prioritization. We also see that current monitoring schemes is not specifically aimed at veterinary medicines, and due to the fact that emissions, temporal and spatial trends, emission routes and concentrations at relevant locations are little available, no clear overview of risks is yet existing. Further noted that the origin of a detected compound cannot always be properly traced back to the original non-veterinary use only. We note that non-veterinary compounds are also used in human medicines or as pesticides. Admission to the market, based on active substances, is therefore sometimes regulated in different rulemaking and also, usage data is scattered. This makes priority setting difficult when performed in a segregated view on the universe of chemicals.

**MO385**

**Comparing methods for estimating environmental emissions**


The environmental risk assessments consist of information on exposure and hazards of chemicals to environmental compartments. Environmental emissions from these biocidal products are estimated according to Emission Scenario Documents (e.g. OECD). In some ESDs, the emission is calculated based on the use/consumption of the product as specified on the label (e.g. PT18), with a number of default assumptions applied. However, other ESDs include the facility to take account of tonnage information as well as average consumption values in product specific calculation models (e.g. PT2). Both approaches have strengths and weaknesses. However, the importance of establishing realistic and reliable methods of estimating environmental emissions cannot be understated, especially in light of the intention to develop guidance on aggregate assessment. Accordingly, this poster will illustrate on two approaches for estimating emissions: regional tonnage (top down) or consumption (bottom up). Opportunities and limitations of the applicability of the data and their implications for use in EU environmental exposure assessments will be evaluated.
Interpretation and uncertainty - overcoming challenges of translating LCA results into reliable information (P)

MO387 Recommendation on Steam Cracker allocation for the sake of comparability of petrochemicals products datasets used in LCA studies

G. Casteland, PlasticsEurope / LCA; P. Saling, BASF SE / Sustainability Strategy

The steam cracker process turns fossil hydrocarbon feedstocks into several different materials, products, and by-products like propylene, ethylene, and benzene. They are all basic building blocks of many chemicals and polymers used in nearly all products and sectors. Thus LCA data of steam cracker products directly influence a huge amount of further downstream products. It is therefore important that LCA data for steam cracker products are modelled consistently, enabling a reduction of uncertainties and a better interpretation by LCA experts, particularly in perspective of comparability, in LCA studies of these downstream products. Basing on ISO 14044 and on the abundant existing literature on this topic the Life Cycle Thinking and Sustainability working group of PlasticsEurope, composed of experts from its member companies, plus some experts of the Chemical Sector of the World Business Council for Sustainable Development, and some LCA consultants have issued a recommendation built through a consensus 5 years long process. The presentation will elaborate on the discussions and on the recommendation finally issued, considered as the best compromise between comparability and specific representativeness. For multi-output processes, such as a steam cracker, ISO 14040 and 14044 standards define a hierarchy of several options. Due to the nature of steam cracker processes allocation is considered as the preferred option. The concept of defining a main "products" fixed list in combination with a mass-based allocation for steam crackers has led to a consistent LCA approach, independent from market prices, technological changes or market driven adaptations of steam cracker outputs. It gives practitioners a clear guidance for the allocation process. This results in less differing environmental data for steam cracker products and will lead to a higher comparability. The results are much more stable, although the same product will have slightly different LCI results depending on different datasets and different amounts of products derived from the steam cracker. Such a collaborative work towards streamlining should be engaged for all chemicals, and should be applied within all database both to background and foreground parts, like for example in the European EF compliant database.

MO388 Actual versus default uncertainty in ecoinvent database

F. Bellizarino, L.A. Oliveira, Institute for Technological Research IPT; M.R. Saade, V. Gomes, University of Campinas UNICAMP; M.G. Silva, Federal University of Espirito Santo; G. Moraga, Universidade Federal do Rio Grande / NORIE; A.B. Passuello, Federal University of Rio Grande do Sul; V.M. John, University of Sao Paulo USP; O.S. Yoshiida, Institute for Technological Research ITP

Variability of national life cycle inventory flows is a relevant uncertainty source and should be properly informed in public databases. Within the scope of the Sustainable Recycling Industries project, life cycle inventories for Brazilian construction products were developed and submitted to ecoinvent following its guidelines, including the preferred use of the lognormal distribution for uncertainty modelling, which requires converting sample average and variation into the geometric mean and the unbiased variance of the underlying normal distribution. However, dataset reviewers inform that most data providers do not perform these conversions and simply use the sample average for flow amounts, frequently associated to default basic uncertainty factors suggested by ecoinvent. This work discusses the implications of three different uncertainty modelling approaches: 1) using both converted mean and variance, 2) using the sample average with the converted variance; 3) using the sample average and default basic uncertainty variance (probably the most common approach). Primary data collected in 25 concrete block factories were used in the analyses. Influence on life cycle impact assessment results was assessed using Monte Carlo simulation with 10,000 iterations, CML 1 A method and ecoinvent v.3.2. "Rest of the World" datasets for upstream processes. Results show that the sample weighted average and the geometric mean differed significantly. Therefore, using the sample weighted average as a proxy for the lognormal geometric mean may overestimate impacts, in our case by approximately 10%, considering only the effects of the concrete block production process flows. Since existing datasets may have followed this approach, the results impact different regions and countries. Furthermore, basic uncertainty values are significant lower than measured variations across manufacturing sites, which is inconsistent with a conservative estimation approach. Thus, uncertainty information provided by ecoinvent might contain inconsistencies and leads to error in uncertainty assessment, such as impact overestimation. Uncertainty modelling can be improved in the database by allowing the input of different amount parameters, performing automatic conversions in the submission software or simplifying the provision of uncertainty data using simpler probability distributions.

MO389 Life cycle assessment of battery systems with harmonized life cycle inventories considering different storage applications

X. Zhang, Paul Scherrer Institute / Laboratory of energy systems analysis; C. Bauer, Paul Scherrer Institute / Laboratory for Energy Systems Analysis; T. Terlouw, Utrecht University / Copernicus Institute of Sustainable Development; M. Beuse, ETH Zurich / Energy Politics Group, Department of Humanities, Social and Political Sciences

The penetration of renewable electricity has greatly increased in the past decade. Battery is a key storage technology to balance supply and demand and to facilitate the world’s transition towards a sustainable energy system. However, having a comprehensive overview of batteries’ life cycle environmental performance still remains a challenge, because battery technologies are of various kinds and the applications of batteries vary. These applications are different from each other in terms of required power and energy size as well as number of cycles. Due to these different requirements by applications, the same battery technology needs to be operated differently and sized accordingly. Numerous studies in the past investigated the life cycle environmental performance of batteries; however, most of them are focused on the application of batteries in electric vehicles, considering a limited number of lithium-ion battery technologies, while the stationary applications of batteries were less explored in limited studies. In addition, these studies are mostly conducted based on diversified sources of life cycle inventory data, without harmonizing the assumptions that are not necessarily different. Peters et al. have recently applied in real scale, the application of nanomaterials as adsorbents but they are compared without considering the applications. Another study by Baumann et al. considers the applications of battery in the assessment, without addressing the country of application, which results in partial understanding of contributions in the life cycle emissions. This study therefore addresses these challenges, by considering six battery technologies for five storage applications in three representative application countries in Europe. On the basis of previous studies, the harmonization of inventory data is carried out to a greater extent. We also extend the scope of the system, which is often limited to battery pack, to include the complete balance of systems, which ensures the operation required by the applications.

MO390 LCA of nano-adsorbents - Interpretation of laboratory results

A. Kazemi, Tarbiat Modares University / Department of Environmental Science, Faculty of Natural Resources; S.I. Olsen, Technical University of Denmark / DTU Management Engineering Division for Quantitative Sustainability Assessment; N. Bahramifar, Tarbiat Modares University / Department of Environmental Science, Faculty of Natural Resources; A. Heydari, Tarbiat Modares Nano-adsorbents as an emerging product and a special application of nanomaterials can increasingly play an important role in the control and removal of environmental pollutants. An example of this is the use of nano-iron to remediate contaminated groundwater. However, even though particularly this example has been initially applied in real scale, the application of nanomaterials as adsorbents is still an emerging technology at the early stages of development. Hence, this study enables an environmental assessment of nano-adsorbents as an emerging product/technology based on the results from the laboratory. Two nano-adsorbents with graphene-based (MGO-NH-SH) and Fe3O4-based (FeOx@SiO2-NH-SH) composites, which function with a similar thiol group for Hg(II) removal are comparatively different stages of the production. Removal of mercury is important due to its historic cases of fatal contamination and its continued use. Although mercury must be removed from the contaminated sites it is still very relevant to make an LCA in order to ensure a balance between the impacts of producing the nanoadsorbent versus the avoided impact of the mercury that is being removed. The environmental impacts of synthesised adsorbents including energy use, climate change, water use, human toxicity, and ecotoxicity are investigated by a stepwise procedure during their synthesis processes, regarding their potential to remove mercury from polluted water (functional unit is removal of 1 kg of Hg(II)). Accordingly, characterization results showed that although the process of the functionalization of nanoadsorbents leads to the increase of the adsorption capacity of them, it also has a significant enhancement of negative environmental impacts. A “what-if” perspective was applied to consider the uncertainties of using lab-scale data for parameters including amounts of acid (HCl + H3SO4), ammonia, ethanol, methanol, DCC (N,N’-dicyclohexylcarbodiimide), NHS (N-Hydroxysuccinimide), water recovery, and electricity. The results of test 1 comparing the impacts between MGO-NH-SH and FeOx@SiO2-NH-SH estimated respectively 37%, 34%, 40, 31, and 26% more climate change, of previous use energy, human toxicity, and ecotoxicity, respectively for the latter. Sensitivity analysis were employed to determine the uncertainties for scale-up production and it is shown that especially potential reductions of electricity use, ethanol and DCC can reduce the impacts significantly.

MO391 Quantifying the influence of consumer behaviour on water, energy and greenhouse gas footprints of shoeing

S. Shahmohammadi, Radboud University / Environmental Science; Z. Steinmann,
Radboud University Nijmegen; H. King, Unilever; H. Hendricks, Unilever RD Colworth; R. University, Radboud University Nijmegen / Department of Environmental Science

Life Cycle Assessment (LCA) has been used as a tool for environmental footprinting of a wide range of household cleaning activities. Even though differences in the way household activities are performed by consumers may alter the results of LCAs, the variability in consumer behaviour is generally ignored in LCAs, which use the average behaviour as a basis for quantifying the environmental impacts. The goal of our study was to demonstrate how the data on consumers’ choices, habits, climatic parameters, manufacturing of products and infrastructure of countries can be combined to quantify the variability in the energy use, greenhouse gas emissions and water footprints related to the life cycle impact of showering. The data footprint of showering were modelled in 4 countries namely: Australia, Switzerland, the United Kingdom and the United States using various data sources to quantify the associated variability. Results showed that both inter-country behavioural, climatic and infrastructural differences as well as intra-country variation in consumer behaviour are crucial for determining the variability in the life cycle environmental impacts. Inter-country variability - the ratio between the highest median footprint and the lowest median footprint over the four countries- in the 4 main output variables of the model i.e. energy use, GHG emissions, water withdrawal, water consumption and water scarcity was a factor of 1.5, 2.2, 1.4 and 5.8 respectively. Intra-country variability - the ratio between the 95th percentile and the 5th percentile of the distribution - was typically higher than inter-country variability and ranged between factors of 5 and a factor of 20 depending on the country and indicator considered. Sensitive analysis showed that consumers’ reasoned choices - particularly heater type and shower flow rate- and their habitual behaviours - particularly shower duration-, are the dominant sources of variabilities. Reductions in the water and energy related impacts of showering through changing of reasoned choices are achievable by one-off decisions such as buying an energy efficient water heater. However, reducing the impacts through changing of consumers’ habits could be challenging and needs more systematic approaches as consumers tend to keep their old habits.

The environment as a reactor determining fate and toxicity of nanomaterials (P)

MO394 Ecotoxicity and fate of Ag and CeO2 nanomaterials in outdoor lysimeter experiments

Nanomaterials (NM) will enter the environment via diverse pathways. Sewage sludge for example is repeatedly applied as fertilizer on farmland due to its high nutrient content. This may cause a significant fraction of the N and Ag to enter the soil. However, there are other scenarios like the exposure of the terrestrial environment via runoff. Therefore, our aim was to investigate the ecotoxicity and fate of CeO2-NM and Ag-NM under environmentally relevant conditions in outdoor lysimeters over around 2 years (CeO2-NM) and 3 years (Ag-NMs). Nanomaterials of the OECD Sponsorship Programme, namely NM-212 (CeO2) and NM-300K (Ag), were used for the experiments. Two concentrations for each CeO2-NM and Ag-NM were applied via sewage sludge into the top 20 cm of lysimeter soil. In addition, CeO2-NM were applied via simulated rainfall over four weeks on the surface of the lysimeter soil and afterwards mixed into the top 20 cm to simulate ploughing. Samples of the soil were incubated under laboratory conditions for 180 days to study the comparability of outdoor and laboratory results regarding ecotoxicity. The results from our long-term lysimeter experiments showed no detectable horizontal displacement in combination with very low remobilization for both tested NM over 2 to 3 years. Thus, indicate that the sludge applied NM and the NM applied via simulated rainfall remained nearly immobile in the pathway between soils and leachate. However, Ag uptake in the roots of wheat, canola and barley indicates that the chemical conditions in the rhizosphere induce Ag-NM remobilization from the incorporated sewage sludge even after three harvesting cycles. The CeO2-NM did not induce any adverse effect on the investigated soil microorganisms and the plant growth. At the higher Ag-NM concentration, a constant inhibition of the soil microflora (ammonium oxidizing bacteria and substrate-induced respiration) was observed over about 3 years in the lysimeter study. However, there was no effect at the lower Ag-NM concentration. Long term ecotoxicological results of the laboratory experiment over 180 days reflect the findings of the lysimeter study. For Ag-NM and CeO2-NM the results indicate that a hazard assessment based on data from laboratory tests is acceptable.

MO395 Long term effects of three different silver sulfide nanomaterials, silver nitrate and bulk silver sulfide on soil microorganisms and plants
K. Schlich, Fraunhofer IEM - Institute for Molecular Biology and Applied Ecology; M. Hoppe, Federal Institute for Geosciences and Natural Resources; M. Kraas, Fraunhofer IEM - Institute for Molecular Biology and Applied Ecology / Ecotoxicology; J. Schubert, Leibniz Institute for Polymer Materials; M. Chana, Institute for Building Materials (IfB); K. Hund-Rinke, Fraunhofer IEM / Department of Ecotoxicology

Silver nanomaterials (AgNMs) are subjected to various transformations along their way into the sewage treatment plant (STP). Hereby the AgNMs are mainly transformed to silver sulfides (Ag2S) (Kaege et al., 2011). Sparingly soluble Ag2S is considered as none toxic to soil organisms. In the STP the AgNMs adsorb to sewage sludge (Schlich et al., 2013) and the arising biosolids will be applied in large quantities on agricultural land within the European Union. The main goal of the present study was to determine, if different types of sulfidized AgNMs evoke a

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difference in the toxicity of the AgNMs. A realistic exposure scenario was chosen. The five test materials NM-300K, previously sulfidized NM-300K, a nanoparticulate AgS, and bulk AgS were added with an influent concentration of 1 mg/L and AgNO₃ with an influent concentration of 0.5 mg/L into the denitrification of a simulated STP continuously for 10 days. The sewage sludge of each treatment was dewatered and the biosolids were mixed with soil. After 60, 90, 120 and 180 days, the microorganisms were separated. From the preliminary data show that there are mostly ions present in the digestive glands, but NPs were also detected when the animals were exposed only to AgNO₃ solution. This points to the formation of secondary NPs inside the organism. In vitro digestive juice model does not entirely represent the expected dissolution rate of NPs that was concluded from in vivo exposure. The usefulness of terrestrial isospecies as models to assess the transformation of NPs will be discussed. This work was funded under NanoFase project (grant agreement No 646002).

**MO398** Energy reserves and respiration rate in the earthworm Eisenia fetida after exposure to zinc in nanoparticle or ionic forms Z.M. Swiatek, Institute of Environmental Sciences, Jagiellonian University / Institute of Environmental Education; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation The energy budget is an indicator of the organisms’ overall condition and the changes in the energy reserves and/or energy consumption rate have been used as biomarkers of toxic stress. To understand better the effect of different forms and concentrations of Zn and possible costs connected with the effective Zn regulation by the earthworms. Eisenia fetida was exposed to ZnO-NPs in a 2.2Kg soil for 21 days (uptake phase), followed by 14 day elimination in clean soil (respiration phase). Two tests were conducted for both ZnCl₂ (250 and 500 μg Zn g⁻¹ dry soil) and ZnO-NPs (500 and 1000 μg Zn g⁻¹ dry soil), corresponding to EC₅₀ and EC₉₀ for reproduction, plus control without added Zn. The results suggest that the earthworms are able to regulate internal Zn concentrations efficiently, regardless of its form and concentration, and can play an important role in mediating contamination to soil plants (WWTPs) and microorganisms. The study aims at assessing the influence of soil type on the bioavailability of Ag and AgS NPs to enchytraeids (Enchytraeus crypticus) and springtails (Folsomia candida). Four soils with different pH (4-7), organic matter (2-17%) and clay contents (3-13%) were used. An uptake and elimination kinetics approach was taking, in which the animals were exposed to a single concentration (nominal 10 mg Ag/kg dry soil) for 14 days (uptake phase), after which they were transferred to clean soil for a 14-day elimination period. A first-order one-compartment model was used to calculate uptake and elimination rate constants. Results for the enchytraeids showed k₁ values for the uptake of Ag ranging between 0.009 and 0.057 g soil/g animal/day for AgS NPs and of 0.107-0.671 g soil/g animal/day for AgNO₃. These data suggest a lower availability of the Ag from the AgS NPs than from the ionic Ag. The k₁ values for the AgS NPs were independent of soil type and showed a different pattern than for AgNO₃. Where lowest availability was expected in the soil with the highest cation exchange capacity (CEC), this indeed was the case for AgNO₃, but not for for AgS. Elimination rate constant values (k₂) ranged between 0.057 and 0.565 per day, and were not dependent on soil type or Ag form. Tests on the springtails are still running.

**MO397** Terrestrial isospecies as models to assess the biotransformation of nanoparticles inside the organisms: an example with silver and gold nanoparticles A. Jarme Kokalj, University of Ljubljana, Biotechnical Fac. / Department of Biotechnology; D. Drobné, University of Ljubljana / Department of Biology Physico-chemical properties of nanoparticles, such as their size, shape and dissolution, depend on their environment. Most commonly anticipated alteration of metal based nanoparticles is their dissolution and alteration in size, which are interrelated. Our previous in vivo studies with ceraspic isopod Porcellio scaber have shown that the dissolution of some metal nanoparticles (NPs), such as copper oxide and silver NPs, drastically increase inside the animals. These in vivo studies were typically the 14 days feeding experiments and afterwards the total metal content (both NPs and metal ions) was analysed in digestive glands of the animals. With the advancement of analytical techniques, such as single particle (sp)-ICP MS, it is now possible to analyse only the NPs content in the digestive gland and distinguish the signal from metal ions. This also enables to prove whether NPs are formed secondary in the organisms after ingestion of metal salt solution. We present a study where terrestrial isospecies were fed silver and gold NPs and their respective metal salt controls via feeding on leaves, and afterwards the NPs and metal content in the digestive gland and rest of the body was measured. In parallel, we also performed an experiment where we exposed the same NPs in simulated in vitro digestive juice and assessed the dissolution rate using (sp-) ICP MS. Preliminary data show that the NPs are mostly present in the digestive glands, but NPs were also detected when the animals were exposed only to AgNO₃ solution. This points to the formation of secondary NPs inside the organism. In vitro digestive juice model does not entirely represent the expected dissolution rate of NPs that was concluded from in vivo exposure. The usefulness of terrestrial isospecies as models to assess the transformation of NPs will be discussed. This work was funded under NanoFase project (grant agreement No 646002).

**MO396** Influence of soil type on the toxicokinetics of Ag and AgS nanoparticles and ionic Ag in soil invertebrates C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science The rise of nanotechnology and the increased use of nanomaterials in consumer products may lead to an increased emission of nanoparticles (NPs) to the environment. Since NPs may leach from products during use, waste water treatment plants (WWTPs) may be an important sink but also an important source of NP emission to the environment. The use of sewage sludge in agriculture may, for example, lead to NP exposure in soils. NPs may undergo transformation when passing WWTPs, with sulphidation being an important process. Silver nanoparticles are among the most used, suggesting that Ag-based NPs also will be among the NPs most likely ending up in soils. And considering the transformation processes taking place in the WWTP, AgS may be a form in which the NPs likely will reach the soil. In soil, sorption, aggregation and dissolution processes will determine the availability of the NPs or released ions for uptake by organisms. Bioavailability will also depend on soil properties that play an important role in governing NPs' fate. This study aimed at assessing the influence of soil type on the bioavailability of Ag and AgS NPs to enchytraeids (Enchytraeus crypticus) and springtails (Folsomia candida). Four soils with different pH (4-7), organic matter (2-17%) and clay contents (3-13%) were used. An uptake and elimination kinetics approach was taking, in which the animals were exposed to a single concentration (nominal 10 mg Ag/kg dry soil) for 14 days (uptake phase), after which they were transferred to clean soil for a 14-day elimination period. A first-order one-compartment model was used to calculate uptake and elimination rate constants. Results for the enchytraeids showed k₁ values for the uptake of Ag ranging between 0.009 and 0.057 g soil/g animal/day for AgS NPs and of 0.107-0.671 g soil/g animal/day for AgNO₃. These data suggest a lower availability of the Ag from the AgS NPs than from the ionic Ag. The k₁ values for the AgS NPs were independent of soil type and showed a different pattern than for AgNO₃. Where lowest availability was expected in the soil with the highest cation exchange capacity (CEC), this indeed was the case for AgNO₃, but not for for AgS. Elimination rate constant values (k₂) ranged between 0.057 and 0.565 per day, and were not dependent on soil type or Ag form. Tests on the springtails are still running.
hemocoe, isopods were injected with gold NPs and then left for 48 hours to recover from the injection; in previous experiments 48 hours was shown to be enough time for hemocyte numbers to return to pre-injection levels. The total number of cells, viability and the proportion of hemocyte types were counted. These counts were then compared to the animals which had been fed NPs and to others that had been injected with a non-lethal dose of LPS. Preliminary data shows that the isopods cellular immune response is altered upon direct injection of NPs, but no such effect was found after their ingestion. The study is still ongoing.

MO402 Toxic Effects of Silver Nanoparticles and Its Transformation Product in Soil Applied with Biosolid

E. Topuz, I. Koyuncu, Istanbul Technical University / Environmental Engineering Biosolids, which are produced as a result of biological wastewater treatment, need to be managed as a separate waste category. Land spread of biosolids to agricultural land, as a resource of nutrients and organic matter, is encouraged under the “Resource Efficiency Roadmap of Europe” [1]. However, the presence of contaminants in biosolids such as engineered nanoparticles can cause concerns. Total Ag concentrations in biosolids can be up to 195 mg Ag/kg dry soil in biosolids according to Johnson et al. [2] which is close to observed ECSO concentrations of Ag nanoparticles (AgNPs) [3]. Moreover, AgNPs are mostly transformed to Ag sulphide nanoparticles (AgSNPs) due to the reducing conditions present in the wastewater treatment plant (WWTP) [4]. Recent studies suggest the possibility of AgNP residues because of the partial sulfidation of AgNPs [5]. Land spread of biosolids might lead to the transfer of AgNPs and AgSNPs to the soil which could pose harm to soil organisms. Hence, this study aims to investigate the toxic effect of AgNPs and/or AgSNPs on earthworms and isopods. Pseudomonas putida was exposed up to 500 mg/L over 21 days. Anaerobic conditions were used for wastewater sludge management. AgNPs-PVP, AgSNP and their different mixtures are spiked to the exposure medium. Survival and reproductive toxicity are determined with the standard toxicity test explained by Castro-Ferreira et al. [6]. Animals and exposure media are analyzed for total Ag concentrations. Therefore, lethal and/or reproductive toxicity are evaluated by considering the Ag concentrations in the exposure media (soil and porewater) and in the animals. Microbial activities are determined in soil samples following OECD and ISO protocols to determine composting rate [7]. Water samples were used following OECD protocols to determine ecotoxicity of nanomaterials in soil. The nanomaterial eisenia fetida earthworms in vivo exposed to silver nanoparticles s. curiees, CONICET PRIET UELU; N. Garcia Velasco, E. Urionabarrenetxea, University of the Basque Country UP/IEHU; M. Saenz, PRIET CONICET, National University of Luján; M. Soto, University of the Basque Country UP/IEHU; W. Di Marzo, CONICET-PRIET / PRIET In recent years the production of nanomaterials (NPs) has increased massively. The subsequent release of NPs into the environment has raised concerns to assess the potential ecological risk in soil, water and air. Silver nanoparticles (Ag-NPs) have the highest degree of commercialization due to their high thermal and electric conductivity, high catalytic activity, and powerful antimicrobial properties. Eisenia fetida is a model specie in soil toxicity studies and has been broadly used due to its sensitivity to different toxicants at different levels of biological organization. The main aim of the present investigation is to understand the effects produced by AgNPs (5.08x2 nm sized and PVP-PEI coated) in comparison with the soluble form of the metal (AgNO3) at molecular level in coelomocytes of E. fetida at different exposure times. E. fetida were in vivo exposed to different concentrations of Ag-NPs and AgNO3 (0.05 and 50 mg Ag/kg soil) through OECD artificial soil for 1, 3 and 14 d. Then, the transcription levels of selected genes associated to oxidative stress (Catalse) and metal detoxifications (MTs-metallothioneins) were determined in coelomocytes extruded from exposed earthworms. In addition, the enzymatic activity (Catalse) and protein content (MTs) were quantified. The responses varied significantly among days, exposure concentration and Ag form. Exposure to Ag-NPs led to...
significant induction of CAT at day 1, followed by an increase in its transcription levels after 3 and 14 d of exposure. Similarly, exposure to AgNO₃ induced the transcription of CAT at day 1 but at day 14 a downregulation was observed. The CAT activity increased at both treatment and exposure times (1 and 3 d). After 14 d of exposure, CAT activity was inhibited at the highest concentration tested. The highest increase of MTS at protein level was observed after 3 d of exposure. Our results indicate that short-term exposures to Ag NPs induced early molecular stress responses (MT induction and oxidative stress) in coelomocytes that precede other responses at higher levels of biological organization. The responses in translocation level in E. fetida tissues were according. The study indicates the importance of using integrative biomarkers for the evaluation of the potential risk of Ag NPs in soils.

MO404
Effects of Cerium Nanoparticles with deferent surface-charge in coelomocytes of Eisenia fetida
c. siriuses, priet coniet; O. Tsusyo, University of Kentucky, Department of Plant and Soil Sciences; J. Li, University of Kentucky, Department of Toxicology and Cancer Biology; M. Saenz, PRICT CONICET, National University of Luqum; W.D. Di Marzio, CONICET-PIRET / PIRET; j. unrine, University of Kentucky, Department of Toxicology and Cancer Biology
With the rapid development of nanotechnology and its broad applications, a wide variety of engineered nanoparticles are used in commodities, pharmaceutics, cosmetics, biomedical products and industries. Cerium oxide nanoparticles (CeO₂-NPs) are used in the industries as the catalyst, and as chemical-mechanical planarization agents in production of silicon wafers. This study investigated the toxicity of CeO₂-NPs with polymer coatings in different charge in coelomocytes of Eisenia fetida earthworms. The CeO₂-NPs (2.5 nm primary particle diameter) were coated with dextran to confer a neutral charge (DEX-CeO₂(0)), diethylaminoethyl dextran to confer a positive charge (DEAE-CeO₂(+)) and carboxymethyl dextran to confer an negative charge (CM-CeO₂(-)). The range of exposure concentrations were 0.02-1562.5 mg Ce/L. The coelomocytes were exposed ex situ for 1 h for each treatment. Then, the transcriptions levels of genes associated with stress (catalase and heat shock protein 70) were determined by q-RT-PCR. In addition, cytotoxicity and genotoxicity were determined by using tripan blue assay and comet assay respectively. The responses varied significantly among exposure concentration and charge of polymer coatings. The results showed that positively charged DEAE-CeO₂ (+) were more toxic that negative and neutral CeO₂-NPs. The results show that initial surface chemistry had a profound impact on the toxicity of CeO₂-NPs to coelomocytes.

MO405
The uptake of pristine and aged silver nanoparticles by wheat, Triticum aestivum, in a soil exposure
A. Green Etalbe, CEH Wallingford; C. Schultz, Centre for Ecology and Hydrology; D. Tarnovska, M. Matzke, NERC Centre for Ecology and Hydrology; D. Spurgeon, Centre for Ecology & Hydrology; C. Svensdon, CEH, Wallingford / Polish Academy of Sciences / University of Poznan / University of Warsaw, Poland.; L. Bouman, Wageningen University / NIMR / University of Groningen
It is expected that most nanoparticles (NPs) which reach the soil will not be in their pristine form but instead will have been transformed by the environment (e.g. sulphidisation of Ag in waste treatment processes). This will greatly influence the form of NP to which soil organisms are exposed and their ultimate bioavailability. The bioaccumulation of NPs inside the organisms can govern their bioavailability. The increasing use of silver nanoparticles (AgNPs) as antibacterial agents in a variety of products have raised the need to assess their environmental impact. The ever-growing application of AgNPs leads to their introduction into wastewater treatment plants (WWTPs) via sewer systems. During treatment, AgNPs are mainly retained in sewage sludge but part of transformed AgNPs is released into the environment. This study aims at investigating the effect of pristine and wastewater treated AgNPs on the activities of coelomocytes (primary immune cells) isolated from the epigean earthworm Derhondraeua veneta that are used as a model to assess the effects of Ag and TiO₂ NPs. Initial investigations focus on Ag (PVP coated, 25 nm, nanoComposix) and TiO₂ particles (uncoated nanat, nominal primary size of 5 µm, NM-101, JRC) and their mixture, to better understand their uptake, interaction with coelomocytes and subsequent cellular effects. Moreover, a lab-scale wastewater treatment system is used to study the transformation of Ag and TiO₂ NPs through biological wastewater treatment processes, and the potential effects of the aged particles through biosolids application is evaluated. Extensive characterization of the particles in exposure media is performed with dynamic light scattering (DLS), single particle-Inductively Coupled Plasma Mass Spectrometry (sp-ICP-MS) and transmission electron microscopy (TEM). The dispersant used in ASTM (4% w/w of each Tagat® TO and Tween® 20) showed both significant decreases (AChEc, GST, CAT) and increase (LDH) of enzymatic activities in dispersant-control relatively to negative-control, suggesting deleterious effects of dispersant to daphnids. Biomarker responses to NM-300K were more marked when added to effluent control comparatively to ASM, especially for higher concentrations. There was a significant decrease of AChE in effluent (25 and 75 µg/L) and ASTM (125 µg/L) media, which implies impairment of control and modulation of neural transmission signal in these experimental conditions. The significant increase of GST and CAT activities at 100 and 125 µg/L in effluent, respectively, suggest oxidative stress. The significant decrease of LDH activity in effluent (25 µg/L) suggests an increase in anaerobic metabolism and higher stress for daphnids. Unexpectedly, there was a significant decrease on LPO at 125 µg/L in ASTM, which could be explained by a decrease of synthesis of total lipids. This study shows that (i) the response of biomarkers to used dispersing agent highlights the need for further study on its effects on organisms prior to its application, in order to understand the AgNPs behaviour in standard test media, and (ii) there is a distinct biomarker response-pattern in daphnids exposed to WWTP effluent containing NM-300K and ASTM supplemented with pristine NM-300K.

MO408
Outlining the behaviour and ecoxotoxicology of biomedical nanoparticles in natural media
G. Grassi, M. Cuperlo, University of Siena / Department of Physical, Earth and Environmental Sciences; D.R. Hristov, University College Dublin / School of Veterinary Medicine; K.A. Dawson, University College Dublin / Centre for
BioNano Interactions; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences

Engineered nanoparticles (NPs), given the multitude of uses, can be released in aquatic environments, both intentionally and accidentally. To date there is no shortage of studies concerning the environmental fate and ecotoxicity of widely used NPs, such as titanium and silver oxides. However, much less is known about NMs, for example doped cerium oxide (CeO$_2$@Eu), carbon dot-doped silica (SiC@B), and polyethylene glycol-functionalized silica (SiO$_2$-B and SiO$_2$-PEG, respectively), and we assessed their behaviour and ecological impacts in natural river- (NRW) and seawater (NSW) environments. Hydraulic diameter sizes were monitored for 30 days by dynamic light scattering (DLS) and showed remarkable differences in NRW compared to NSW of both bare and PEGylated SiO$_2$ NPs. In fact, SiO$_2$ NPs dispersions were found to be stable in NRW, while an immediate instability was observed in NSW. PS-NH$_2$, CeO$_2$@Eu and SiC NPs did not show such a clear distinction between the two natural media, reaching micrometric sizes after 24 h. In order to address sedimentation phenomena, normalized derived count rates (DCR) were used to estimate the activity of suspended NPs in both media. SiO$_2$B and SiO$_2$-PEG NPs remained suspended in NRW until 10 days, while in NSW the sedimentation regime was steeper and hardly any signal was collected form suspensions after 24 h. On the contrary, no such difference was observed for PSNH$_2$, CeO$_2$@Eu and SiC NPs, which completely settled within 24 h. NPs structural integrity was monitored as well over 30 days by means of spectrophotometric assays. SiO$_2$-based NPs bioaccumulation studies were carried out in benthic invertebrates (Hydrobius azteca) which were extracted via transmission electron microscopy (TEM) imaging, while PSNH$_2$ maintained an intact structure in NRW and NSW. Finally, algol growth inhibition tests were performed using freshwater and marine microalgae (OECD, 1994). PSNH$_2$ and CeO$_2$@Eu were toxic in the OECD synthetic freshwater media only, while the remaining NPs types did not show any sign of toxicity. A significant (p < 0.05) reduction in PSNH$_2$ and CeO$_2$@Eu NPs toxicity was observed repeating the tests in NRW, while again no toxicity was confirmed in NSW. Altogether, our results provide a realistic insight in the fate and toxicity of diverse NPs, also highlighting the importance of testing complex natural matrices for a more realistic risk assessment.

**MO409 Development of a method for the analysis of nanoparticles in the freshwater clam Corbicula fluminea**


The aquatic ecotoxicity of a marketed nanosilver product measured in original samples as well as in spiked samples. The results obtained for analytical methods of correlative microscopy. The derived accumulation factors and the exposure period was measured by ICP-MS or ICP-OES to determine the rate of the tested silver nanoform was determined and the dissolution of the silver nanoform was measured (ICP-MS) as well as (ii) particle inductively coupled plasma-atomic emission spectroscopy (ICP-AES) to prove that the animals fed control sludge were not in contact with Ag NMs. The study was carried out with five replicated test vials with two groups of amphipods each. Water samples were taken within the test period to measure the silver content in the media and to prove that the animals fed control sludge were not in contact with Ag NMs potentially released from the contaminated sludge. After an exposure period of 7 (21) days Ag content of the water and animal samples collected at the end of the exposure period was measured by ICP-MS or ICP-OES to determine the accumulation of Ag in both groups. The presence of NMs in the animals was examined by high-resolution transmission electron microscopy (TEM) and methods of corelative microscopy. The derived accumulation factors and the results of the TEM investigations allow to evaluate the contribution of particulate and dissolved Ag to the accumulation of Ag from STP effluent.

**MO412 Ecotoxicity of silica and silver nanoparticles (ENPs) on hyporheic copepods - a direct comparison with ionic silver**

K. Arijs, ARCHE; D. Leverett, wet; A. Korts, ARCHE; J. Mertens, Precious Metals and Rhenum Consortium c/o EPMF; K. Schlich, M. Brüggemann, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology

As part of the REACH Substance Evaluation for silver, new data was required to be generated to further justify read-across from ionic silver to silver nanoflans. Therefore, the aquatic ecotoxicity and fate and behaviour of ionic silver and the smallest silver nanoflom with the highest specific surface area registered under REACH were tested. An ecotoxicity testing programme was undertaken considering the effects of this silver nanoflom with silver nitrate using the following intrinsically environmentally relevant ecotoxicity tests: Toxicity to the alga, Pseudokirchneriella subcapitaata (OECD Test Guideline No. 201). Long-term toxicity to Daphnia magna (OECD Test Guideline No. 211). The silver nanoflom was fully characterised and was an aqueous suspension containing approximately 37% nanoparticles with spheroidal-like shape (mean primary particle size 9.4 nm). Total silver, conventional 'dissolved silver (0.45 μm membrane filtered) and Fe-dissolved silver (3 μm centrifuge filtered) were measured (ICP-MS) in samples taken from test vessels. Membrane filters (0.45 μm) and centrifuge filters were conditioned before use with the test solution/dilspersion to be filtered. Particle size & Zeta Potential were determined (DLS) in vessels without test organisms. Elemental particle size distribution was analysed in separately prepared samples of the test item in test medium by means of an asymmetric Flow-Field-Flow-Fractionation (4F) coupled to ICP-MS (for the silver nanoflom only). Based on measured silver concentrations, silver nitrate was more toxic than nanosilver to both algae growth and Daphnia reproduction, for all silver fractions. Size and Zeta Potential measurements are inconclusive for all tests and it appears that the test concentrations were too low / particles too few to resolve from control / background level (using the Zetasizer Nano equipment). In addition, the dissolution rate of nanosilver was still significantly higher than the dissolved ionic silver in the ecotoxicity tests over a period of 28 days (following OECD Test Guideline No. 29), with measurements of the same three silver fractions. This showed a different dissolution behaviour in both test media, which agreed with observations in the ecotoxicity tests.

**MO411 Investigations on the uptake pathway and accumulation of silver from manufactured silver nanoparticles in the freshwater amphipod Hyalella azteca**


Testing nanomaterials (NMs) under environmentally relevant conditions is an important aspect regarding the risk assessment of nanomaterials that enter the water cycle. To this end, the uptake pathway and the accumulation of Ag NMs into the aquatic environment we developed a coupled test system using the effluents of model STPs in a chronic exposure test with the epibenthic amphipod Hyalella azteca, which is commonly used for ecotoxicity studies. Previous studies with this test system showed that silver (Ag) from silver NMs is accumulated by H. azteca exposed to model STP effluents. However, the pathway of Ag accumulation, via ingestion of particulate Ag and/or bioconcentration of dissolved ionic silver, is still unknown. To further elucidate the uptake pathway of silver from model STP effluent, two groups of H. azteca with five animals each were placed in a single test vessel. The two groups were separated by a stainless-steel strainer. One group was fed contaminated sludge from model STPs, loaded on glass fibre filters. The second group, located in the stainless-steel strainer, was fed uncontaminated control STP sludge and had no direct contact to the test sludge containing Ag NMs. The study was carried out with five replicated test vials with two groups of amphibods each. Water samples were taken within the strainers to measure the silver content in the media and to prove that the animals fed control sludge were not in contact with Ag NMs potentially released from the contaminated sludge. After an exposure period of 7 (21) days Ag content of the water and animal samples collected at the end of the exposure period was measured by ICP-MS or ICP-OES to determine the accumulation of Ag in both groups. The presence of NMs in the animals was examined by high-resolution transmission electron microscopy (TEM) and methods of corelative microscopy. The derived accumulation factors and the results of the TEM investigations allow to evaluate the contribution of particulate and dissolved Ag to the accumulation of Ag from STP effluent.
liquid effluents 0.03 – 6.74 and 0.003 – 0.26 µg/L for Si and Ag NPs respectively. Environmental exposure models have shown that soils and sediments can provide important reservoirs of these nanomaterials, especially in the presence of high concentrations of DOM. These such as the humic substances found in water, sediment, and soil, are one of the substances capable of interacting with ENPs. To understand and assess the effects of NPs on the environment, should be well established quantitatively the concentration-response relationships. Also, to know how these NPs can be regulated the environmental quality and, thus, their toxicity. Designed studies are therefore required in order to understand the fate, transport, stability, and toxicity of nanoparticles. By the other hand, there are not many studies about the effect of ENPs on hyporheic copepod species and less related with DOM concentrations. The hyporheic zone is a region underneath streamlined that integrates surface and groundwater. Its location is central to biogeochemical linkages between the riparian zone, dissolved nutrients, and benthic biota. Even if is in this DOM sources are relatively constant, biogeochemical processing within the hyporheic zone resulted a DOM pool that is temporarily dynamic regarding its composition and concentration. In this study we evaluated how DOM concentrations and water hardness are related with the acute ecotoxicity of Si and Ag NPs on the survival of Metacyclops rhachodes a widespread hyporheic species. Toxicity of AgNPs was related with DOM concentrations and showed a non-significant Beta for water hardness. On the contrary, for SiNPs, DOM and water hardness quantitative relationships were negatively correlated with ecotoxicity on this freshwater invertebrate.

**MO413**  
**Long-term exposure of ZnO nanoparticles to freshwater microalgae cultivated in batch and semi-continuous mode**  
A.F. Aravantinou, F. Andreou, I. Manariotis, University of Patras / Civil Engineering

Nanoparticles (NPs) have always existed in the physical environment. The rapid development of commercial applications involving the use of a large variety of synthetic nanoparticles has resulted in the introduction of higher amounts of nanoparticles in the environment. As the use of NPs increases, their effect to the coastal food chain and ecosystems is crucial. The aim of this work was to investigate the toxic effect of zinc oxide (ZnO) NPs on freshwater microalgae in batch and semi-continuous feeding mode for longer period than the time used in typical toxicity tests. Scenedesmus rubescens was selected as model microorganism since it is a common freshwater microalgae. S. rubescens exposed to ZnO NPs concentrations varying from 0.081 to 810 mg/L for 28 days in batch mode conditions, while in semi-continuous mode it was exposed to 0.081µg/mL of ZnO NPs. The cultures were grown in modified Blue-Green 11 medium (BG-11). The effect of ZnO NPs was assessed in two synthetic wastewater mimicking a growing rate, nutrient removal and lipid production. The toxic effect of ZnO NPs was estimated by the half maximum inhibition concentration (IC50) and the growth inhibition rate (%) according to OECD 201 guideline. The experimental results in the batch mode conditions revealed that microalgae growth was significantly affected by the exposure time and the NPs concentrations. Specifically, the results showed that after a period of time the microalgae were adapted in the presence of ZnO NPs and were more resistant. In the semi-continuous mode the growth of S. rubescens was greater in the presence of ZnO NPs, and the lipid content was higher.

**MO414**  
**Effects of sunscreen-derived TiO2 nanoparticles on freshwater and marine organisms**  
S. schiavo, ENEA CR; M. Oliviero, University Parkhenopec; A. Philippides, Universität Koblenz-Landau / Institute for Environmental Sciences Group of Environmental and Soil Chemistry; s. manzo, ENEA / SSPT-PROTER-BES

Sunscreens represent one of the main source of engineered TiO2 nanoparticles (TNPs) source in coastal ecosystems, especially during summer period. Their adverse effects were generally investigated using bare model TNPs and only few studies were based on the NPs extracted from commercial products. Therefore, this study aims to evaluate the effect of TNPs extracted from three different commercial sunscreens upon freshwater and marine organisms: microalgae (Pseudokirchneriella subcapitata; Dunaliella tertiolecta) and crustaceans (Eurystenopoda longicornis) and the effect exerted by the whole sunscreen was lower in respect to the toxicity exerted of TiO2 and of TiO2 industrial nanopowder. In D. magna instead the LD50 of particles extracted from one sunscreen was lower than values previously determined for ITPNs. No significative differences between tested substrates were highlighted with the acute test upon A. salina. These findings suggest that the product formulation may mitigate the toxic effects of TNPs either by direct modification of TNP properties (reactivity, bioavailability) or by providing organic and inorganic nutrients promoting phytoplankton and hence microalgae growth. Moreover the organic UV filters could limit the amount of light that the particle receive and thus limit the photocatalytic activity. Our preliminary results then showed a different TNP toxicity in the two ecosystems: in particular the TNPs different physico-chemical behaviour and reactivity depending on testing environmental media and even the specific interaction with organisms should be taken into account in designing the experimental assessment. Further studies are needed to better understand the real availability of the NPs for organisms also taking into account the UV radiation.

**MO415**  
**Silver nanoparticles affect the early development of Tisbe battagliaii: pristine vs aged particles**  
A. Gerasimopoulos, Norwegian Institute for Water Research NIV K. J. Farkas, SINTEF Ocean / Environmental Technology; K. Løvgren, Norwegian Institute for Water Research; P.A. Carvalho, SINTEF Materials and Chemistry; A. Booth, SINTEF Ocean / Environmental Technology; A. Macken, NIVA / marine pollution

Silver and titanium nanoparticles are used in numerous consumer products and applications and they are likely to enter wastewater streams, reach wastewater treatment plants and aquatic systems through wastewater and effluent discharge. Nanomaterials undergo transformations in different matrices altering their fate, behaviour, bioavailability and toxic potential that could differ greatly from the pristine counterparts. There are challenges on the detection and quantification of nanomaterials at environmentally relevant concentrations in complex media and matrices such as whole organisms. Moreover, studies on uptake and effects of transformed particles on marine species is largely lacking. The aim of the present study is to better understand the transformation of Ag and TiO2 NPs in wastewater and assess the uptake, bioaccumulation and subsequent developmental effects of pristine and transformed particles on the marine organism Tisbe battagliaii. In this study the harpacticoid copepod Tisbe battagliaii was selected as a relevant marine species and the effects on the naupliar development was assessed over an exposure period of 6 days. The mortality and the developmental stage of the organisms was assessed daily. Initial investigations focus on the study of Ag (BP treated in 5 nm, nanoComposite) and TiO2 particles (nominal primary size of 5 nm, NM-101, JRC) and their mixture. Moreover, the particles were aged in synthetic wastewater (for 4 hours under stirring conditions) and the effects of “aged” particles on the uptake, bioaccumulation and naupliar development was assessed. Extensive characterization of the particles in synthetic wastewater, seawater and exposure media was performed with dynamic light scattering (DLS), ultraviolete –visibile spectroscopy (UV-VIS), single particle-Inductively Coupled Plasma Mass Spectrometry (sp-ICP-MS) and transmission electron microscopy (TEM). Moreover, nanoparticle uptake, bioaccumulation and intracellular localisation is evaluated with TEM and sp-ICP-MS. Results showed that the both particles types were stable in seawater and the effects on naupliar development was negligible. In contrast, particle concentrations decreased over time in seawater, which was likely due to both dissolution and aggregation for Ag, and aggregation in TiO2; TiO2 particles were found to be more stable in seawater after the aging process, which can affect their impacts on exposed organisms.

**MO416**  
**Silver concentration in the haemolymph of a tropical marine amphipod fed with silver nanoparticles and silver chloride**  
M. Vannucci-Silva, UNICAMP / Institute of Biology; S. Cadore, University of Campinas; G. Umbuzeiro, School of Technology, UNICAMP / LAEG

The relatively recent development of engineered Ag nanoparticles has expanded silver applications considerably. Silver nanoparticles (AgNP) tend to agglomerate in the aqueous phase and settle to sediment surfaces exposing deposit feeding organisms. Amphipods, like Panyhale hawaiensis, are deposit-feeding species ecologically relevant, becoming an excellent model for ecotoxicology studies. In addition to the traditional toxicity studies, internal doses determination, for example in the haemolymph, can provide information on the level of exposure to toxic metals. The aim of this study was to investigate Ag concentration in the haemolymph of the marine amphipod Parhyale hawaiensis exposed to food containing AgNP and AgCl. We hypothesized the actual AgNP could be absorbed by the gut leading to a higher amount of Ag in the haemolymph when compared to AgCl. Silver nanoparticles < 100nm (Sigma Aldrich) or elemental Ag (from AgCl, Sigma Aldrich) were incorporated into a fish diet (10 mg Ag per fish per day). A feeding period of approximately 200 mg kg⁻¹ P. hawaiensis organisms (8 months) were placed individually into a plastic container (100 mL of reconstituted saline water) and fed on alternate days with control, AgNP, or AgCl amended feed pellets. After 1 hour of feeding, each organism was washed and placed into a new plastic container with clean salt water to ensure that the exposure was only via food. The amphipods were then fed daily during 7, 14 and 28 days. After exposure, the haemolymph was collected using a thin glass capillary, weighted and analysed. Three pooled samples of 4 organisms (2 females and 2 males) were tested per exposure concentration. The silver determination in haemolymph was carried out by a Graphite Furnace Atomic Absorption Spectrometry (GFAAS). A higher amount of silver in the haemolymph was absorbed from AgNP feed, reaching 8.4±0.7 mg kg⁻¹ in comparison to 3.7±1.0 mg kg⁻¹ for AgCl. at the longest exposure time. The increase of silver concentration was related to the exposure duration. Therefore, it appeared that ingested silver is more bioavailable to P. hawaiensis as AgNP than when it is in its salt form. Data strongly suggest that nanoparticles were uptaken by the gut and distributed in the
haemolymph causing this increase in Ag content. More studies are required to verify the Ag form present in the haemolymph and how it will induce damage in the exposed organisms.

MO417
Toxic effects of multi-walled carbon nanotubes on bivalves and comparison between functionalized and nonfunctionalized nanomaterials
L. De Marchi, University of Aveiro, Department of Biology & CESAM / Departamento de Biologia & CESAM; V. Neto, Department of Mechanical Engineering & Centre for Mechanical Technology and Automation (TEMA), University of Aveiro 3810-193, Portugal; C. Pretti, Department of Veterinary Sciences, University of Pisa, San Piero a Grado; E. Figueira, University of Aveiro / Biological & Computational Department, University of Aveiro

232.2 induction of slight IL-6 cytokine induction, probably due to its smaller size, higher agglomeration tendency and capacity to induce ROS. This study is partially financed by FP7-NANO2REG project, Grant n. 310584.

MO419
Transformations of engineered nanomaterials during wastewater treatment: the role of engineered surface coatings and the impact on environmental fate
M. Sorette, Oregon State University / School of Chemical, Biological, and Environmental Engineering; J.A. Nason, Oregon State University / Chemical Biological and Environmental Engineering; R. Kaege, Eawag - Swiss Federal Institute of Aquatic Science and Technology

Previous research has highlighted the importance of particle-particle interactions in controlling the environmental fate of engineered nanomaterials (ENMs). Yet our ability to accurately predict the outcome of these interactions within environmental systems is still limited. One obstacle is the inherent complexity of these interactions which depend on several factors, including the properties of the ENM. However, the properties of the ENM are dynamic and can be altered via myriad transformation processes (e.g., over-coating via natural macromolecules, surface coating displacement, etc.). When considering the pathways by which ENMs may be released to the environment, wastewater treatment plants (WWTPs) not only act as gateways controlling the release of ENMs but they may also serve as reactors adjusting the properties of the ENMs. Therefore, to improve our understanding of ENM interactions within environmental systems we must first understand the extent to which ENM properties are altered within WWTPs. A. Zielonka.

MO420
Freshwater sediments as an environmental reactor: defining biologically relevant fate parameters to provide context for nanomaterial bioaccumulation
R. Cross, University of Exeter; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; T.S. Galloway, University of Exeter / Biosciences

As the field of nanotoxicology matures there is a call for the research focus to progress from hazard identification to more ecologically relevant assessment of the risk that engineered nanomaterials (ENM) pose as they undergo a range of transformations in the environment. This will require test designs prioritising environments most at risk of contamination, and which not only measure ecologically relevant endpoints, but also characterise the fate, transformations and behaviours of particles within the test system, providing the context for differences observed between treatments. Freshwater sediments present an ecosystem in need of further research, as these are predicted to be major sinks of ENMs entering the aquatic environment though waste water treatment and terrestrial pathways during material production, use and disposal. Whilst freshwater sediments have been identified as an ecological compartment at risk of contamination, very little is known about the fate of ENMs entering these sediments. We present a simple separation method to isolate the colloidal (< 200 nm) and dissolved (> 1kDa) fractions of the sediment pore water, which can be run alongside biological exposures. This provides the context for how these biologically accessible fractions of ENMs in the sediments may relate to intrinsic particle properties such as size, core composition and coatings. Using cerium oxide (CeO₂-NP) and silver nanoparticles (AgNPs) we study the fate of these materials in the freshwater sediment dwelling worm Lumbriculus variegatus. By following the fate of these particles in the solid bound, colloidal and dissolved fractions of the sediment, we provide context to explain differences in both the route and extent of uptake of these materials by the worm. This poster presents the successful application of this method to investigate the implications different particle properties may have on their fate through these sediments.

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the sediment and lack of dissolution (< 1% of spiked cerium was extractable with water). Transdermal uptake of AgNP was attributed to dissolved silver in the pore waters and uptake of soluble silver, potentially through localised dissolution of particles at the worms’ surface.

MO421 Examining the role of TiO2 nanoparticle surface transformations on transport and toxicity A.R. Deline, Oregon State University / Environmental Engineering; J.A. Nason, Oregon State University / Chemical Biological and Environmental Engineering

Titanium dioxide nanoparticles (TiO2 NPs) have great potential for use in a variety of commercial and environmental applications, including the photocatalytic treatment of contaminants. While processes like microbial inactivation and the generation of reactive oxygen species (ROS) have been studied under a variety of irradiation and water chemistry conditions, there exists limited mechanistic insight as to how these processes are related to the molecular-level surface transformations that may occur under different environmental conditions. This study is using surface-sensitive characterization techniques, including x-ray photoelectron spectroscopy (XPS), to examine the impact of UV irradiation, temperature, and water chemistry exposures on the metal oxide surfaces of both pure anatase and mixed anatase-rutile TiO2 NPs. Initial XPS studies of the impact of simulated solar irradiation revealed that solar irradiation resulted in a decrease in the aliphatic carbon present on the TiO2 surface and an increase in the oxygen-bonded carbon, with no observable effect on the oxidative properties of the metal oxide. Additional studies will examine the surface chalcophosphate electrochemistry for both bare and AuNP-modified TiO2 surfaces to determine if, to date, our Fresnel lens to increase the irradiation intensity and solution temperature. The relationships between these molecular-level surface properties and the extrinsic properties of the TiO2 NPs are being further explored using a suite of functional assays. Assays that have been optimized for the characterization of TiO2 NPs in this study include methylene blue dye degradation (photocatalytic activity), rose bengal dye reduction (photodynamic activity), and fluorescein dye conversion (ROS generation).

Ultimately, changes in the properties of the TiO2 NPs will be compared to larger scale environmental behavior, allowing for a better understanding of the specific role that surface structure plays in nanoparticle transport and toxicity.

MO422 Influence of organic compounds on the sulfidation kinetics of copper oxide nanoparticles A. Gogos, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Process Engineering, Particle Lab; A. Voegelin, R. Kaege, Eawag - Swiss federal Institute of Aquatic Science and Technology

Organic compounds released to the environment from engineered nanomaterials (ENM) will inevitably come into contact with different types of dissolved organic matter (DOM). It has been shown in a large number of studies that DOM influences the colloidal properties of ENM, which in turn impact subsequent transport and transformation processes. Sulfidation, as an important environmental transformation process, has significant implications for the fate and the ecological effects of metals. In this study, we will examine the effects of DOM, including humic substances, on the sulfidation of CuO nanoparticles (CuO NPs), the sulfidation reaction and its kinetics have been described in detail. However, the influence of DOM on this reaction has not been investigated, yet. Due to their high concentration of bisulfide (HS\(^{-}\)), wastewater systems represent major sulfidizing compartments, where the DOM mainly consists of proteins, polysaccharides and humic substances. In this study, we therefore selected three organic model compounds (Bovine serum albumin (BSA, model protein), Alginate (model polysaccharide) and Polyacrylic acid (natural organic matter analogue)) and were analyzed for both the size and number concentration in order to establish the scale environmental behavior, allowing for a better understanding of the specific role that surface structure plays in nanoparticle transport and toxicity.

MO424 Assessing potential risks of Nanodrugs and their delivery systems in fish using Light Sheet Microscopy D.L. Windell, University of Exeter / College of Life and Environmental Sciences; J. Moger, The University of Exeter / College of Engineering, Mathematics and Physical Sciences; M.J. Winter, The University of Exeter / College of Life and Environmental Sciences; S. Owen, AstraZeneca / Safety Health Environment; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences

Nanotechnology applications have increased dramatically in recent years including in the pharmaceutical sector. The unique properties of nanoparticles have been exploited in medicine in both drug development and drug delivery. Their small size and capability for manipulation and functionalisation allows for great improvements in drug efficacy. Nanomedicines can cross a wide range of biological membranes and barriers (including the blood brain barrier facilitating the diagnosis and treatment of life threatening diseases such as cancer. Although nanotechnology may help to reduce the toxicity and side effects of drugs, the actual carriers themselves may also have the potential for inducing toxic effects, depending on their composition. This raises the need for safety evaluations of these drug delivery systems both in patients, but also with respect to their potential for environmental impact. Very little is known regarding the potential impacts associated with the release of these nanodrugs or their carrier systems into the environment, although some studies have begun to investigate the potential toxic effects of various nanoparticle shapes and coatings in aquatic organisms. Using various sizes of gold nanoparticles (between 10 and 100nm in diameter) with a non-reactive metal polymer and fluorophore coating, we have traced their uptake and tissue partitioning using a casper mutant zebrafish and light sheet microscopy. We have constructed a light sheet system based on the OpenSPIM platform, (SPIM - Selective Plane-Illumination Microscopy) which allows us to create 3D images and 4D videos in real-time. Using this rapid image acquisition technique we showed a size selective uptake of the nanoparticles into the kidney and minimal uptake in other tissues. Depuration studies indicated a steady loss of the gold nanoparticles from the pronephric kidney over time. We also investigated for biological responses using specific zebrafish transgenic lines for oxidative stress and kidney function. We are now investigating the effect different coatings and functionalisations have on the uptake and distribution of gold nanoparticles in the larval zebrafish ultimately with the aim of beginning to define the potential for this important new group of medicines for having an environmental impact on fish.

MO425 SETAC Nanotechnology Interest Group C. Svendsen, CEH, Wallingford / Pollution and Ecotoxicology

Hydrophobic Chemicals and Mixtures: Reliable Investigations on their Environmental Fate and Effects (P)
MO426
Effect of ageing on polycyclic aromatic hydrocarbon composition of biochar G. Siegmund, Technische Universität München / Chair of Analytical Chemistry and Water Chemistry; T. Bucheli, Agroscope ART / Environmental Analyses; I. Hilber, Agroscope / Environmental Analyses; T. Hiffer, M. Kah, T. Hofmann, University of Vienna / Department of Environmental Geosciences
The influence of ageing on biochar properties has been investigated by comparing three standard biochars from greenhouse tomato waste (BC) that were artificially aged by either H2O2 thermal oxidation or horseradish peroxidase enzymatic oxidation. In addition, a field-aged counterpart for one of the biochars was recovered from an agricultural field site, four years after application. Biochar bulk properties showed only minor changes following both artificial and field ageing, indicating high biochar stability. Concentrations of the 16 US EPA PAHs were measured in all of the biochars and a contaminant trap was used to investigate the effect of ageing on their bioaccessibility. The concentrations of total and bioaccessible PAHs ranged from 4.4 to 22.6 mg/kg and 0.0 to 9.7 mg/kg, respectively. Concentrations of the 16 US EPA PAHs decreased following field ageing, but the proportion of low molecular weight PAHs increased. The observed changes in PAH composition with field ageing can partially be explained by uptake from the surrounding soil. In addition, size discriminatory intra-biochar transfer processes also contributed to the changes in PAH composition. To better understand changes in PAH composition with ageing, an additional broad range of alkylated PAHs was also analyzed in selected samples. Our results show that the tested artificial ageing protocols are unable to approximate the changes in PAH composition resulting from field ageing. Nevertheless, total and bioaccessible PAH concentrations decreased for both artificially and field-aged biochars, indicating that some PAHs are released when they are freshly produced and that the risk of PAH release decreases with ageing. Therefore, well-produced biochars that meet European Biochar Certificate (EBC) and International Biochar Initiative (IBI) quality thresholds for total PAH concentrations are unlikely to present a risk with regard to PAH release following field application. These results have recently been published (doi: 10.1039/C7EM00116A).

MO427
Field testing of a new calibration approach for silicone passive samplers: Comparison of the concentration ratio method using samplers of different thicknesses with the PRC approach H. Fuchshuber, Institut für Umweltforschung / Institute for Environmental Research BioV; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; K. Smith, RWTH Aachen University / Institute for Environmental Research
Silicone passive sampling is a common method for sampling bioavailable concentrations of waterborne hydrophobic pollutants in the environment. Often, silicone 1mm samplers have to be used in kinetic mode and sampler calibration is unavoidable. Most commonly, exchange kinetics are derived from the release rates of performance reference compounds (PRCs) spiked into the sampler prior to usage. Unfortunately, PRCs can be expensive and are not always available for all compounds. Due to these challenges, a complementary calibration approach using passive samplers of different thicknesses has been developed and investigated in laboratory trials. This study describes the testing of the approach in situ in the field. The sampling location was a storm water retention pond collecting storm water run-off from a motorway. The pond has two basins, one of which is equipped with a Floating Treatment Wetland (FTW) for cleaning the run-off. Two sets of duplicate samplers with 3 different thicknesses were installed in the inflow, after the FTW and in the reference basin without a FTW. One set of samplers was taken out after three and the second after five weeks. These were extracted and analyzed for PAHs, with the concentration ratios for the different thicknesses used to calculate the field dissolved concentrations. All samplers had been additionally loaded with PRs, with the decreases also used to calculate the field levels. These were compared to the results from the concentration ratio approach, underlining its suitability as a complementary calibration method and its application domain.

MO428
Use of biochar for hexaclorocyclohexane sorption: a mechanistic approach L. Silvani, g. cornelissen, s.e. hale, Norwegian Geotechnical Institute
Hexachlorocyclohexanes (HCHs) are halogenated compounds composed of 4 main isomers: γ-HCH, β-HCH, α-HCH and δ-HCH, which differ for their tridimensional structure. Commercial HCH in technical grade is a mixture of these isomers. HCH has been extensively used as a pesticide despite the fact that only γ-HCH (lindane) has insecticide properties. HCHs’ toxicity, carcinogenic, teratogen and neurotoxic effects have been reported in humans; and the HCHs have a clear tendency to accumulate in the environment. For these reasons, HCHs are contaminants of worldwide forensic concern. This study investigated the removal mechanism of γ-HCH from the monocomponent isotherms. Various remediation techniques have been used to remove HCHs in aqueous solution, among these, adsorption is the most common used one. Biochar (BC) is a carbonaceous material that is a promising sorbent amendment material due to its high adsorption of organic and inorganic contaminants, and to its low cost. In this study three standard biochars, from digestate (BCa), from greenhouse tomato waste (BCg) and from durian shell (BCd), have been used as sorbent materials for the HCHs removal from water. The BCs used cover a wide range of surface area (5.4 - 328.6 m² g⁻¹), pore volume (5.1 - 186.6 cm³ g⁻¹), pore dimension (1.05 - 5.85 Å), pyrolysis temperature (400 – 700 °C) and surface properties (including iron content). Batch isotherm tests were carried out in deionized water with the single isomers and the mixture of α-, β-, γ- and δ-HCH. The HCH concentration was ranged between 1 and 500 µg L⁻¹ in the monocomponent isotherms and between 5 and 2000 µg L⁻¹ (total concentration) in the mixture isotherms. Polyethylene (PE, 26 cm × 2 cm × 0.6 cm, 0.07 g) was used as a passive sampler for assessing the HCHs concentration in water. The sorption performance of the biochars is related to physiochemical properties. Preliminary results have shown the adsorption descriptions are correlated with the BC surface area and iron content, where a higher adsorption is observed as surface area and iron content increase. Clear differences in the behavior of the isomers were observed.

MO429
Development of a Method for Measurement Freely Dissolved Concentrations of Alkylated PAHs Using Solid Phase Microextraction with PDMS Fibers M. Renningen, RWTH Aachen / Bioi; T. Parkerton, Exoxmobil Biomedical Sciences Inc. / Toxicology & Environmental Science; G. Witt, HAW Hamburg / Department of Environmental Biology
Frequently, the total PAH sediment concentration reported for a sample has been based on 16 individual priority pollutants according to the U.S. EPA Method 8310. For pyrogenic sources of PAHs (e.g. incomplete burning processes), the parent PAHs are the predominant species. In contrast, PAHs from petrogenic sources (e.g. crude oil) are dominated by alkyl PAHs. Therefore, the U.S. EPA narcosis model established for PAHs is not applicable. For assessing the concentrations of the alkylated PAHs (PAHs) (so-called 34 PAHs) in sediments expressed as organic carbon normalized concentrations (COC) for evaluating risks to benthic organisms based on the calculated magnitude of PAH toxic units (TU) (Hawthorne et al., 2006). However, due to the heterogeneous nature of organic carbon in field sediments, potential risks of adverse biological effects from sediment-associated contaminated material are most commonly assessed on the basis of concentrations of the chemically (CPM) in sediment pore water, not to CCM. Recent advances in equilibrium passive sampling methods (EPSMs) offer a promising alternative to the measurement of CCM and support improved risk-based decision making since bioavailability of sediment contaminants can be directly quantified via CCM. (Mayer et al., 2015, Burkhart et al., 2017). When using EPSMs, polymer or water partition coefficients are crucial for reliable calculation of CCM. To date partitioning coefficients are available for parent PAHs across different polymers (e.g. PDMS, POM) (Lydy et al., 2015). In this study, an equilibrium passive sampling method was developed for investigating alkylated PAHs in marine and limnic sediments and used for risk evaluations of both pyrogenic and petrogenic PAHs. The method is based on solid phase microextraction (SPME) with different silicone materials (PDMS coated glass fibers and hollow fibers). Partitioning coefficients for the PDMS coated fibers (KPDMS) were calculated for selected target alkylated PAHs which have previously not been available. KPDMS for additional alkylated PAHs of interest were then predicted based on the experimentally reported KPDMS values. Finally, the new method was demonstrated by in-situ deployment at seven field stations of different pollution levels. Further insights between in-situ and ex-situ EPSM deployment were obtained by comparing the results of in-situ CCM measurements with corresponding laboratory derived measurements using sediments collected from the same stations.

MO430
Spatial Distribution of HOCs on the Palos Verdes Shelf Superfund Site A.R. Taylor, University of California Riverside / Environmental Sciences; J. Wang, University of California Riverside; D. Schlenk, J. Gan, University of California, Riverside / Department of Environmental Sciences
Hydrophobic organic contaminants (HOCs), such as DDTs, PCBs, and currently used pesticides contaminate soils and sediments all over the world. As they are hydrophobic in nature, these compounds are resistant to both chemical and physical degradation while also having a strong affinity for soil or sediment particles and organic matter. Often, this contamination is due to the historic or current use and manufacture of these compounds, such as the widespread contamination of the Palos Verdes Shelf by DDTs and PCBs, which continue to pose health hazards to ocean organisms and humans. Fish from this area have historically used pesticides, such as fipronil and pyrethroids, have also been detected in sediment from the shelf during preliminary experiments, indicating that these contaminants may have been deposited onto the shelf via urban waterways. In this study, we assessed the spatial distribution of current-use insecticides pyrethroids and fipronils in the top 2 cm of sediment on the Palos Verdes Shelf Superfund Site. Concentrations of total pyrethroids (Cypermethrin, Lambda-Cypermethrin, Cyhalothrin, Cyfluorin, Cyfluthrin, Cypermethrin, and cis-Permethrin) ranged from n.d. to 170.15 ng/g and total fipronils (Fipronil+ fipronil desulfinyl, fipronil sulfide, fipronil, fipronil sulfone) ranged from n.d. to 5.59 ng/g. On-going research also aims to understand the spatial distribution of legacy HOCs (PBDEs, DDTs, PCBs) in the shelf area and assess their bioavailability in order to determine their risk to both organisms living on the shelf and possible routes of human exposure. These findings will be made available to the federal and state agencies for use in environmental risk assessment and designing management strategies. References
Delle Site, A. Factors affecting sorption of organic compounds in natural
MO431 PAHs in water and surface sediments from Douro River estuary and Porto Atlantic coast (Iberian Peninsula, North Portugal) — Risks for biota and human health?
M. João Rocha, ICBAS – U.Porto, CIMAR; C. Cruzeiro, CIMAR; L.J. Dores-Sousa, VUB / Department of Chemical Engineering; C. Cruziero, CIMAR; L.J. Dores-Sousa, VUB; CEF, CCTUC, U.Coimbra; R. Rocha, ICBAS – U.Porto, CIMAR; CIMAR – LTE. The following data shows the occurrence of 16 priority compounds (PAHs) in surface waters from the Douro River estuary and nearby Atlantic seacoast. These areas bath Porto and Gaia cities, widely known by the production/export of the famous Porto wine. This area, besides being highly industrialized, also holds an oil refinery, an important harbour, intense maritime traffic, and recreational marinas. For this study, water samples were taken from four strategic sampling sites, at six different times of the year. These samples were extracted by ultrasound technique (suspended fraction) and solid-phase extraction (dissolved fraction), before their quantitative analysis by gas chromatography – mass spectrometry (GC-MS). Data showed the presence of all analysed PAHs in all samples, which global amounts (216 PAHs) were extremely high in both analysed matrices and at all sampling sites. In fact, average concentrations attained ≈ 52 μg/l of dissolved PAHs and ≈ 0.73 mg/kg of suspended PAHs. These data are the first reported in this geographic area and can be used as a starting point for future control of the PAHs levels either locally either at the European scale. Acknowledgements: European Regional Development Fund (ERDF) through COMPETE, Framework of the Structured Program of R&D&I INNOVAMAR — Innovation and Sustainability in the Management and Exploitation of Marine Resources (NORTE-01-0155-REEF-000355), Research Line ECOSERVICES, supported by the Northern Regional Operation Programme (NORTE2020), through the ERDF. ICBAS – U. Porto. Keywords: PAHs, carcinogenic, estuary, sea, monitoring.

MO433 Occurrence and availability of PACs and total AhR agonists in contaminated soils - Combining in vitro reporter gene assay and chemical analysis with passive sampling and column leaching
M. Larsson, Orebro University / Man-Technology-Environment research centre (MTM); M. Lam, RWTH University Aachen; P. van Hees, Orebro University / MTM Research Center; J. Giessy, University of Saskatchewan / Department of Veterinary and Biomedical Sciences; and S. Söder, centre; M. Kingwood, Orebro University / Man-Technology-Environment research centre (MTM) Polycyclic aromatic hydrocarbons (PAHs) are common contaminants at industrial sites, and occur as complex mixtures of thousands of PAHs and heterocyclic compounds (NSO-PACs) among others, collectively referred to as polycyclic aromatic compounds (PACs). The contaminant composition differ widely due to contamination sources and pathways presenting the high complexity in PAC-contaminated areas, current risk assessment of PACs is commonly based on chemical analysis of the 16 US EPA PAHs. Consequently, many PACs are unknown. There is an urgent need of improved and applicable analytical methods to assess environmental levels and fate of potential toxic PACs to evaluate risk to human health and the environment. An important concern regarding sites contaminated with PACs is the risk of groundwater contamination by release of the compounds from soils. The aim of this study was to investigate the occurrence of 77 PACs including PAHs, alkyl-PAHs, oxy-PAHs and NSO-PACs among total aryl hydrocarbon receptor (AhR)-agonists in soils from historical contaminated sites and to assess the availability of the compounds in the soils. A novel approach combining chemical (GC/MS) and bioanalytical measurements (H4IE-luc) combined with characterization of availability by use of a column leaching test and passive sampling was used. This approach allowed screening of potentially toxic metabolites of PACs in soils during remediation. The results show that chemical analysis of 16 US EPA PAHs to determine the degree of contamination of PACs in soils greatly overlooks toxicologically relevant PACs. Agonists in contaminated soils were characterized to be significantly higher than the 16 PAHs. The concentrations of PACs in all soils, indicating low availability of the compounds in soils. Theachable fraction was generally greater for more hydrophilic PACs, such as more polar PACs composed of two or three rings. Contribution of the analyzed PACS to the overall AhR-mediated activities detected in soils, leachates and passive samplers was pretty small and confirms presence of several other AhR agonists in soils. Only a small fraction of AhR agonists were available in soils, indicating an overestimation of the risk, if only total initial concentrations in soils would be considered in risk assessment. However, the results show that analysis of available fractions based on only 16 US EPA PAHs have the potential to underestimate the risk of the soils.

MO434 Verification of read-across for aquatic hazard properties of Petroleum Substances in REACH registrations
Y. Verhaegen, CONCAWE; C. Hughes, Shell Health / Risk Science Team; L. Cernedini, ExxonMobil; S. Wouters and L. St. A. D. Redman, ExxonMobil Biomedical Sciences / Toxicology and Environment Science Division; M. Comber, Mike Comber Consulting; S.A. Villalobos, BP / Global Product Stewardship; V. Ochoa, Cepsa; S. Linington, BP; E. Vaiopoulou, European Petroleum Refiners Association Petroleum substances are examples of UVCBs (substances of Unknown or Variably Characterized Biological Activity). Complex mixtures of industrial products or Biological materials, whose complex chemical composition will vary depending on, amongst other things, the source of crude oil, the refinery processing and climate conditions. These substances present additional challenges when conducting environmental hazard and risk assessments under regulatory schemes such as REACH, and Concawe has developed bespoke models for these purposes. However, for purposes of hazard classification and labelling there is still a need for experimental aquatic toxicity test data on petroleum substances. Concawe substances have been organised into categories, based on similarities in refinery processes and physicochemical properties, resulting in a clustering of comparable chemical compositions and related hazard profiles. Applying read-across within a category is an established concept to fill in data gaps and to reduce unnecessary testing, and has been applied to available aquatic toxicity data for Concawe substances using a worst-case approach. ECHA recently released its Read-Across Assessment Framework (RAAF) for environmental endpoints, however the RAAF for UVCBs is still under development due to their added complexity. One recommendation of the RAAF when applying a category approach is to present data in a matrix to demonstrate that properties are similar or follow a regular pattern. In this presentation a category data matrix will be presented for the Concawe category of vacuum hydrocracked gas oils (VHGO). Available historical experimental aquatic toxicity data will be presented alongside substance identity information, predicted EL50 and toxic unit (TU) values calculated using PETROTOX, and results from biomimetic extraction solid phase microextraction (BE-SPME) screening studies. The latter is a technique which measures bioavailable hydrocarbons, and has been demonstrated to correlate well with experimental and predicted aquatic toxicity data. The resulting, complimentary dataset forms a weight of evidence upon which to justify category approaches to the read-across of experimental toxicity data.

MO435 Automated Solid Phase Microextraction (SPME) for measuring freely dissolved concentrations of hydrophobic chemicals in soils, sediments and other solid matrices
C. Vitale, University of Insurbia; K. Knudsmark Sjøholm, University of Copenhagen / Dept. of Plant and Environmental Sciences; A. Di Guardo, University of Insurbia / Department of Science and High Technology; P. Mayer, Technical University of Denmark / Department of Environmental Engineering In risk assessment of hydrophobic chemicals that are strongly associated to the soil/sediment organic matter, freely dissolved concentrations (C_{org}) are more representative than total concentrations (C_{total}) of their actual bioavailability, potential for bioaccumulation and toxicity. Such freely dissolved concentrations can be measured by Solid Phase Microextraction (SPME) if operated in the equilibrium and negligible depletion mode. Furthermore, in order to reduce the measurement variability, increase sample throughput and to produce high quality data, automated SPME methods are promising. The aim of this study was thus to investigate (1) how to operate automated SPME on solid samples, (2) how to achieve equilibrium sampling for hydrophobic organics within a practical time span and (3) how to calibrate the new approach. Polychlorinated biphenyls (PCBs) served as model compounds and matrices included soil, sediment and sludge.

MO436 New approaches for determining solubility of volatile liquid chemicals
H. Birch, DTU Environment / Department of Environmental Engineering; L. Thomsen, Technical University of Denmark / Environmental Engineering; P. Mayer, Technical University of Denmark / Department of Environmental Engineering Water solubility is a fundamental parameter in environmental risk assessment of chemicals, and is theoretically a simple parameter to determine. For hydrophobic chemicals in the liquid state, the main challenge is to establish equilibrium between the pure liquid phase and the water phase within a reasonable time frame, while droplet formation. The first approach uses passive dosing from a saturated silicone polymer in order to saturate the water, while the second approach equilibrates the water with the pure phase liquid through the headspace. Equilibrium time in the range of minutes to hours is expected for the two methods. Four liquid hydrophobic
chemicals within the logKow range of 4.4-8.6 will be included in the study, and results from both methods will be compared.

MO437 Headspace passive dosing for dose-response testing of volatile hydrophobic organic chemicals
L.N. Tran, Technical University of Denmark / Environmental Engineering; S.N. Sorensen, Technical University of Denmark / Department of Environmental Engineering; M. Holmstrup, Aarhus University / Department of Bioscience; P. Mayer, Technical University of Denmark / Department of Environmental Engineering
Constant and well-defined exposure is crucial for the toxicity testing of liquid organic chemicals with high Henry’s constants, which are prone to substantial evaporative losses. A simple and effective headspace passive dosing method was developed and then applied to control the exposure of the freshwater algae Raphidiocelis subcapitata and the terrestrial springtail Folsomia candida to terpenes and alcanes in toxicity experiments. The headspace passive dosing method applies a liquid partitioning donor placed in the headspace of the closed test vial for controlling exposure while avoiding direct contact and introduction of pure phase micro-droplets. Passive dosing from the pure liquid compound was applied for toxicity testing exactly at the solubility limit, and a dilution series of test chemicals prepared in purified vegetable oil served as donor for dose-response testing. The terpenes (S)-Limonene and (S)-Pinene were tested in both the algal growth inhibition test and the springtail test. In addition, n-nonane, n-undecane and n-dodecane were tested on the algae, while iso-octane, iso-dodecane and n-dodecane were tested on the springtails. Our first results demonstrated that (1) the headspace passive dosing method is a simple yet effective way to control exposure to volatile hydrophobic organic chemicals and (2) that the method is straightforward to apply in algal growth inhibition and springtail toxicity tests. Further analyses of exposure parameters are in progress to better understand and quantify the resulting toxicity.

MO438 Application of biomimetic solid phase microextraction to characterize aquatic hazard of petroleum substances
L. Carraro, ExxonMobil Petroleum and Chemical; A.D. Redman, Exxon Mobil Biomedical Sciences / Toxicology and Environment Science Division; J. Butler, ExxonMobil Biomedical Sciences, Inc / Environmental Toxicology and Chemistry Laboratory; D. Letinski, ExxonMobil Biomedical Sciences Inc; E. Vaiopoulos, European Petroleum Refiners Association
Environmental hazards of petroleum substances differ in response to variable substance composition. In response CONCAWE has initiated a comprehensive project to extend analytical characterization of petroleum substances to further support hazard classification within and across petroleum substance categories. As part of this work, SPME and toxicity data for newly characterized substances (n=139), across approximately 10 major categories, were compared to historical data. New compositional data were used as input to PETROTOX to predict bioavailability. In this study, the extractions were done into seven cell-based bioassays covering cytotoxicity, activation of metabolic enzymes (binding to the arylhydrocarbon receptor, AhR), specific, receptor-mediated effects such as estrogenicity (ERa); and adaptive stress response (oxidative stress, AREc32). Cytotoxicity was assessed in all bioassays and occurred occasionally. Moreover, four of the seven bioassays were positive for AhR (one case in 2012, the percentage of AhR activation vs. AhR gamma (PPARγ) and ERa). The activation of the AhR was by far most responsive and showed a distinct pattern across the sampling locations. The other three assays showed responses only at higher enrichment factors of the extracts, also revealing specific contamination patterns. A comparison between Cbio vs. Ctotal will enable assessing the actual risk (Cbio vs. the potential hazard of those chemicals that might be released in future scenarios (Ctotal). The presented work calls for more detailed studies at specific sites and testing of additional endpoints with the aim of obtaining a complete picture of mixture effects caused by the freely dissolved and total concentrations of hydrophobic organic chemicals in sediments.

MO441 Bioaccumulation of hydrophobic organic compounds in aquatic biota: addressing current challenges for in tissue passive equilibrium sampling
E. Rojo-Nieto, Helmholtz centre for environmental research - UFZ / Department of Cell Toxicology; J. Koschorreck, Umweltbundesamt; m. muz, UFZ - Helmholtz Centre for Environmental Research / Cell Toxicology; A. Jahnke, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Toxicology
Organisms living in environments contaminated with Hydrophobic Organic Compounds (HOCs) can enrich these chemicals, a process known as bioaccumulation. Current bioaccumulation assessment, based on exhaustive extraction of HOCs followed by lipid-normalisation, cannot distinguish between cases when bioaccumulation is driven by bioconcentration (passive uptake) or by bioenrichment (uptake + food). This study addresses challenges related to the understanding of HOCs transfer in aquatic food webs, across trophic levels and between environmental compartments (sediment, water, biota). The recently proposed approach based on using ratios in chemical activity as a metric for bioaccumulation assessment represents a major advance relative to the traditional ones, since it aims at expressing the data on a common basis to enable direct comparison among compounds. Passive sampling devices (PSDs) have been developed to address this gap. The presented work is one subproject of the ERC-funded project “CHEMO-RISK” which aims, amongst others, to address the bioaccumulation of HOCs in aquatic biota on a thermodynamic basis. We will develop silicone-based PSDs in order to broaden the use of these devices to those media that are equilibrating slowly, as is the case in lean tissues. For this purpose, homogenated fish tissues from the German Environmental Specimen Bank, with different lipid contents (ranging from 1 to 5% samples/sites and log BAFav, averaged 4.0±0.3, 4.4±0.3, 4.7±0.3, 3.9±0.7 and 4.3±0.4 for galalolate, traeolide, phantolide, celestolide and tonalide respectively. Overall, the empirical models fit reasonably well the bioaccumulation of polycyclic musks in both caged and native molluscs in tropical mangroves. The study of the bioavailability of hydrophobic compounds in highly dynamic environments such as mangroves can be sometimes intricate, and the usefulness of passive samplers and sentinel species such as bivalves was confirmed in the present study.

MO440 Effect-based characterization of mixtures of environmental pollutants in sediments collected between the Arctic and Australia
A. Jahnke, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Toxicology; M. Landmann, Helmholtz Centre for Environmental Research - UFZ GmbH / Department of Cell Toxicology; M. Bergmann, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research / HGF-MPG Group for Deep-Sea Ecology and Technology; J. Bräuning, The University of Queensland / Queensland Alliance of Environmental Health Sciences (QAEHS); S. Schaefer, Federal Institute of Hydrology / Biochemistry and Ecotoxicology; A. Sobek, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology
There is a multitude of pollutants that combine persistent and hydrophobic properties. In aquatic environments, they are largely deposited in sediments. The amount and characteristics of the organic carbon determine how strongly they are bound or if they are readily available for partitioning to biota and biouptake. These pollutants can be accumulated by aquatic organisms and biomagnified to higher trophic levels. Hence, it is important to explore the composition, activity and effects of environmental mixtures of pollutants in sediments of different origin, characteristics and pollution history. Sediments from Sweden, the European Arctic (coastal Svalbard vs. open sea), Queensland (Australia) and a French-German river were collected. The freely dissolved concentrations (Cfree) of the chemicals were determined using equilibration with thin coatings of silicone on the inner walls of glass jars with subsequent solvent extraction. Total sediment concentrations (Ctotal) were determined using accelerated solvent extraction. While there is a wide range of pollutants that have been detected in sediments world-wide, traditional chemical analysis cannot cover all compounds and their transformation products. Therefore, in this study, the extracts were dosed into seven cell-based bioassays covering cytotoxicity, activation of metabolic enzymes (binding to the arylhydrocarbon receptor, AhR), specific, receptor-mediated effects such as estrogenicity (ERa); and adaptive stress response (oxidative stress, AREc32). Cytotoxicity was assessed in all bioassays and occurred occasionally. Moreover, four of the seven bioassays were positive for AhR (one case in 2012, the percentage of AhR activation vs. AhR gamma (PPARγ) and ERa). The activation of the AhR was by far most responsive and showed a distinct pattern across the sampling locations. The other three assays showed responses only at higher enrichment factors of the extracts, also revealing specific contamination patterns. A comparison between Cbio vs. Ctotal will enable assessing the actual risk (Cbio vs. the potential hazard of those chemicals that might be released in future scenarios (Ctotal). The presented work calls for more detailed studies at specific sites and testing of additional endpoints with the aim of obtaining a complete picture of mixture effects caused by the freely dissolved and total concentrations of hydrophobic organic chemicals in sediments.
lipid), have been selected to optimise silicone-based PSDs for sampling in lean tissues. For this study, silicone is used as common reference phase, with sampler relocations across the homogenated samples along the sampling period, as has been proposed by Rusina et al. [1], in order to avoid the local depletion of the sample in direct contact with the silicone, and both, kinetic and equilibration approaches have been considered. The 7 indicator PCBs (28, 52, 101, 118, 135, 153, 180) have been selected as target compounds, covering a log value range from 5.66 to 7.15.


MO442

Widespread occurrence of 4-Nonylphenol, BHT, and 2,4-DTBP in blue crab, Callinectes sapidus, malepae in the northern Gulf of Mexico

S. Chiasson, Loyola University / EEB; E.K. Grey, Governors State University / Division of science, mathematics, and technology; D.A. Grimm, Tulane University / Coordinated Instrumentation Facility; C.M. Taylor, Tulane University / Ecology & Evolutionary Biology

The blue crab, Callinectes sapidus, is an ecologically and economically important invertebrate species in the northern Gulf of Mexico (NGOM). The NGOM receives nearly 60% of drainage from the river systems in the continental United States. Blue crab megalopae collected over three years from multiple estuaries in the NGOM from Texas to Florida were tested for alkylphenol contamination using GC/MS. We found alkylphenols at various stages of blue crab development with 4-nonylphenol (NP), butylated hydroxytoluene (BHT), and 2,4-di-tert-butylphenol (DTBP). NP is an alkylphenol known to impair endocrine function and concentrations detected in megalopae in 2010 and 2011 exceeded the lower limit of the No Observed Effect Concentration range for aquatic invertebrates set by the U.S. Environmental Protection Agency. BHT is a common preservative in food, pharmaceutical, and cosmetic products and is released to the marine environment, but exhibits low toxicity. All compounds have high partition coefficients, which explains their presence in animal tissue. Concentrations of NP, BHT, and DTBP were highly correlated in megalopae over time at most study sites, implying a common source. The relatively high NP concentrations detected in juvenile blue crabs across the NGOM suggests that management strategies of alkylphenols in the environment and toxicological effects on juvenile blue crabs need to be considered

MO443

Real-time visualization and quantification of perylene bioaccumulation at single cell level

S. Xu, School of Environment, Beijing Normal University; X. Jin, Beijing Normal University; F. Bai, Peking University

Hydrophobic organic chemicals (HOCs) are of special ecotoxicological concern because they can be directly incorporated and bio-concentrated in living organisms. However, the effects of self-clustering of HOCs on their environmental behavior and toxicity is not well understood. The self-assembly of HOCs is considered as a defense mechanism to protect marine pollutants, but exhibits low toxicity. All compounds have high partition coefficients, which explains their presence in animal tissue. Concentrations of NP, BHT, and DTBP were highly correlated in megalopae over time at most study sites, implying a common source. The relatively high NP concentrations detected in juvenile blue crabs across the NGOM suggests that management strategies of alkylphenols in the environment and toxicological effects on juvenile blue crabs need to be considered

MO444

Impregnation factors of freshwater fish by organic micropollutants in the Marne Hydrographic network

N.F. Molbert, UPMC UMR METIS 7619 / Biogeochemistry; M. Chevreuil, EPHE / UMR METIS 7619; F. Alliot, EPHE / UMR Metis; R. Santos, HEPIA; J. Mouchel, UPMC UMR METIS CNRSUPMC; A. Goude, EPHE / UMR METIS

Ecotoxicology faces the challenge of monitoring the levels of an increasing number of chemicals on biota. While persistent pollutants have been largely studied, several pollutants are metabolized, especially by vertebrates. Despite the higher toxic potential of metabolites compared to their parent compounds, little attention has been given to metabolites. Several persistent micropollutant families (Polychlorinated Biphenyls (PCB), Organochlorine Pesticides (OCP)) and metabolizable ones (Polycyclic Aromatic Hydrocarbons (PAH), phthalates, pyrethroid pesticides), as well as their metabolites were measured in a free-living freshwater fish, the European chub (Squalius cephalus, N = 113) caught by electrofishing operations in the Seine watersheds. The occurrence of pollutants was characterized in muscles and their metabolites in bile and liver using gas chromatography (GC–MS / MS) and high performance liquid chromatography (HPLC–MS / MS) coupled to a mass spectrometer. Body burdens of pollutants in chubs were then explained according to the environmental (water surface and sediments) contamination and individual parameters (age, body length, health status and parasitic load). Despite restrictive legislation, persistent pollutants (OCP, PCB) were found in all environmental matrices and fish tissues. Pthalates were the most abundant chemicals, with concentrations in fish muscles in the range 141.6-2200 ng g⁻¹. Positive correlations were detected between the environmental pollution and the levels of persistent pollutants (PCB, OCP) in chubs, but not for the metabolizable chemicals, likely due to their rapid degradation and excretion. No correlation was found between micropollutant levels and health status of chubs, suggesting low ecotoxicological effects of these contaminants exposure in the Mame hydrographic network. Surprisingly, chubs infected by the acanthocephalan Pomphorhynchus laevis showed high accumulation of pollutants. The relatively high NP concentrations detected in juvenile blue crabs across the NGOM suggests that management strategies of alkylphenols in the environment and toxicological effects on juvenile blue crabs need to be considered

MO445

Environmental occurrence and distribution of organic UV stabilizers in the sediment of the North and Baltic Seas

C. Apel, Helmholtz-Zentrum Geesthacht; R. Ebinghaus, Helmholtz-Zentrum Geesthacht / Department for Environmental Chemistry

Organic UV stabilizers are of emerging environmental concern due to their large production volumes and potential endocrine disrupting properties. UV stabilizers are widely used in plastic products, paints and coatings to improve the product stability against UV light. Furthermore, some UV stabilizers are approved as ingredients in personal care products like sunscreens to protect human skin against harmful effects of UV radiation. The pathways into the marine environment are either indirect by wastewater treatment plant discharge or direct by recreational activities like bathing and boating. Benzenzoic and benzophenone type UV stabilizers are classified as SVHC (Substances of Very High Concern) under the EU legislation REACH. Numerous others are currently listed under the European community rolling action plan (CoRAP) to be (re-)evaluated in the next years. Due to their chemical properties, most UV stabilizers accumulate in sediment (logKow > 3) and have potential for persistence or pseudo-persistence. Environmental data from coastal and maritime locations is limited. In the study of UV stabilizers in sediment samples of the North and Baltic Seas were analysed for 19 commonly used organic UV stabilizers. The sample pretreatment and analysis was carried out as following: First, the samples were homogenized with sodium sulphate. Afterwards, extraction and clean-up was performed using an accelerated solvent extraction (ASE-350, Dionex, Germany) method. For this, 22 mL stainless steel ASE cells were filled with 50 mg deactivated silica and approximately 5 g sediment that was spiked with appropriately labelled standards. The cells were extracted using dichloromethane for three 10 min-cycles at 100 °C. The extracts were solvent-changed to methanol and reduced in volume to 150 µL. The instrumental analysis was performed on a LC-MS/MS system (1290 Infinity coupled to 6490 triple quadrupole LC/MS, Agilent Technologies, Germany) equipped with an APPI-source and a C18 column (Eclipse Plus RRHD 1.8 µm, 2.1 x 150 mm, Agilent Technologies, Germany). Total Organic Carbon (TOC) analysis was carried out with aliquots of the freeze-dried samples using a LECO RC612 multichapse (Germany). This study shows levels of contamination and distribution of organic UV stabilizers in surface sediments of the North and Baltic Seas for the first time. Several substances have been identified in concentrations in the low ng/g dw range.

MO446

Is Lake Como a "uniform lake"? Information from its inhabitants (zooplankton and fish)


Lake Como, a subalpine lake (Northern Italy), is an oligotrophic lake, with complete water mixing occurring after particularly windy and cold winters. It presents a typical shape of an upside “Y” where a western, eastern and northern basin can be identified. In more detail, the western branch is distinctly separated from the rest of the lake by an underwater ridge, where the highest depth is measured (425 m at

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ARGENNO), and does not present an outlet, resulting in a longer real water renewal time. On the other side, waters of the eastern branch are encouraged to flow towards south directly through the Adda River, which is also the main inlet in the northern branch. Western and eastern branches also present different level of trophic status. In the present work, we investigate if these main morphological features can lead to differences a) in zooplankton density and biomass, b) in the interactions between zooplankton and phytoplankton, and c) in levels of pollution between the pelagic areas of the two branches, evaluated along a seasonal sequence. Preliminary data tell that the taxa composition of the pelagic planktonic communities is the same in the basins but differences in density and biomass are highlighted. These differences are found in levels of contamination of legacy compounds (DDT, PCB) while there are not differences between the two branches in concentrations of perfluoralkyl substances (PFAS).

MO448 Kinetic Sorption and Bioaccumulation of Hydrophobic Organic Chemicals in Marine Plankton Food Chain

F. Ko, National Museum of Marine Biology and Aquarium/ National Dong Hwa University / Institute of Marine Biology; C. Chu, National Dong-Hwa University / Institute of Marine Biology;

Bioaccumulation and distribution of polycyclic aromatic hydrocarbons (PAHs) over different amounts of exposure time were investigated in the plankton food chain including phytoplankton and zooplankton. The simulated plankton food chain was using phytoplankton (Tetraselmis chuii), rotifers (Brachionus sp.), and copepods (Anacopriella sp.) cultured in a gas purging system with a steady supply of PAHs for 7 days in this study. The results show that PAH accumulation in plankton can be roughly divided into three sections: 0.2-1 hours, 1-2.4 hours, and 24-168 hours. The PAH concentrations in plankton varied greatly over the 0.2-1 and 1-2.4 time hour intervals, then approached study-state at 24-168 hours exposure. The low molecular weight PAHs (ACN, AC) were found at significantly higher levels compared with those in high molecular weight PAHs (FA and PY) were found at significantly higher levels in phytoplankton, indicating that plankton might have selectivity towards PAHs. In principal component analysis (PCA), the plankton could be separated significantly into phytoplankton and zooplankton. Parts of the PAH accumulation found in rotifers and copepods were similar which demonstrated that PAH composition in plankton might be affected by trophic levels. All PAHs demonstrated significantly linear relationships between bioconcentration factor (BCF) and PAH hydrophobicity ($K_{ow}$) in plankton, however the different linear regression slopes of log BCF and log $K_{ow}$, between phytoplankton, rotifer and copepod, suggested that the plankton have different pathways of PAH accumulation.

MO449 Do weathered multiwalled carbon nanotubes influence the distribution of the biocide trichloroacarin in a sediment-water system?

L. Bener, J. Politowski, P.M. Hennig, H. Hollert, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics;

The multiwalled carbon nanotubes (MWCNT) are widely used nanomaterials in a variety of different products and processes, well-known for their high sorption capacity. Due to increasing usage and production, exposure to the aquatic environment either accidentally or via disposal of CNT-containing products might increase likewise. Weathering processes like radiation can alter nanoparticle properties and lead to changes in their environmental behavior. The study investigated the influence of the weathered MWCNT (wMWCNT) in the water phase on the concentration and distribution of the biocide trichloroacarin (TCC) in a sediment-water system. The substance was chosen because of its hydrophobic properties and strong affinity to sorb on MWCNT. The concentration of wMWCNT has a significant impact on the distribution of TCC in natural water. 100 µg and 1000 µg wMWCNT/L in Milli Q water led to an adsorption (log $K_{ow}$ in OECD medium: 7.6 L/kg) of 10% and 65% $K_{ow}$-TCC, respectively. We will report experiments on the distribution of TCC in water containing wMWCNT. Therefore, we tested the wMWCNT concentrations of 1 mg wMWCNT/L and subsequently incubated in a sediment-water system in the dark for 180 days. The concentration of TCC-TCC was reduced by 80% when released to soil wMWCNT and accumulate in the natural sediment by fast sedimentation of wMWCNT-TCC complexes. Production and release of carbon based nanomaterials are predicted to further increase in the near future, thus the interactions of nanomaterials with organic pollutants will be of growing importance to assess environmental consequences. Acknowledgements: The work is supported by the European Project NANO-Transfer that receives funding from the Bundesministerium für Bildung und Forschung (BMBF) under agreement with the FP7 ERA-NET SIiNN.

MO450 When technical limits triggers risk assessment for non-biodegradable insoluble pharmaceutical molecule

B. Journel, E. Beltran, CEHTRA SAS; P. Adrian, CEHTRA;

Pharmaceuticals represent a specific category of substances as they are difficult to analyze by standard sampling methods and their experimental results may subject to imprecision. Due to analytical difficulties, parameters such as water solubility and $K_{ow}$ are often expressed as “lower than” or “higher than” and have no defined value. Additionally, model softwares such as EUSES impose maximum value for $K_{ow}$ and minimum value for water solubility as input parameters, whereas EU TGD spreadsheet allows to consider the experimental results. The decision on the parameter values and models to be considered needs then expert judgment. We will present the case of a pharmaceutical molecule currently studied, for which water solubility and then $K_{ow}$ cannot be precisely measured experimentally. While staying regulatory compliant and reflecting the experimental results, the input values chosen for these parameters have a significant impact on calculated PECs for this insoluble molecule. Studies on fate and behaviour in soil and water/sediment are to be conducted, however considering the technical difficulties to analyse the molecule, and the route of environmental exposure, it may be necessary to define a category of molecules for which some of current regulatory requirements could be waived related to their chemical properties. A proposal for an appropriate risk assessment will be provided.

MO451 Effect of environmental characteristics on the bioavailability of hydrophobic organic compounds to fresh water organisms from natural aquatic systems

L. Teunen, University of Antwerp; C. Belpaire, Research Institute for Nature and Forest INBO; R. Blust, L. Vervoets, University of Antwerp / Department of Biology (SPHERE Research Group);

Many aquatic ecosystems are under persistent stress due to influxes of anthropogenic chemical pollutants. High concentrations can harm entire ecosystems and be potentially toxic to humans. The European Water Framework Directive (WFD) obliges member states to monitor chemical compounds in surface waters and to set quality standards that are protective for the ecological integrity. Generally, most of the target chemical compounds are present in non-dissolvable form in environmental samples. However, in the case of highly hydrophobic compounds, their very low water solubility precludes direct measurement in water, and thus alternative monitoring strategies are needed. Accordingly, the WFD has formulated biota quality standards (BQS) which refer to concentrations of compounds that have to be monitored in fish and invertebrates. In the present study we investigated the reliability and relevance of BQS by studying the relationships between concentrations of hydrophobic compounds in environmental compartments (mainly in sediment) and concentrations in biota. Our study encompasses 22 field locations at which we are monitoring the concentrations of a set of hydrophobic organic compounds and total Hg in both sediment and biota (fish and mussels). In addition, some sediment characteristics, i.e. organic carbon content (TOC) and clay content are measured and water characteristics are assessed in levels of pollution between the pelagic areas of the two branches. The simulated plankton food chain was consisting of the four main trophic levels. Our study shows that the plankton have different pathways of PAH accumulation.
have been recently detected. Consequently, their study has become a priority among the main bodies responsible for protecting public health and the environment, such as the European Commission and USEPA. However, the current knowledge about the occurrence and fate of PCPs is still scarce, especially in less developed or developing countries as Brazil. Thus, this study aims to evaluate the occurrence of PCPs in surface sediments of selected areas along the southern and southeastern Brazilian coast through the optimization and implementation of a state of the art methodology. Preliminary results obtained for surface sediment samples from São Paulo coastal areas through microwave-assisted extraction (MAE) and triple-quadrupole mass spectrometer analyzes (GC-MS/MS) revealed the presence of UV-filters (especially octocrylene and EHMCh) and fragrances (tonalide and galaxolide). The next steps of this work include testing additional extraction methodologies, extraction salients and clean-up procedures to improve the detection and quantification of these compounds. The final results of this work will provide the first extensive dataset on the occurrence, levels and fate of PCPs in the Southern Atlantic which will not only contribute with new and rather scarce data but also with valuable information for regional and global inventories.

MO453 IFRA Environmental Standards and RIFM Safety Assessment Program Advances Update for 2018

A. Łapczynski, RIFM / Environmental Science; D.T. Salvito, Research Institute for Fragrance Materials (RIFM) / Dept of Environmental Science; C. Gonzalez, IFRA

To assure safety of fragrance ingredients in consumer products, International Fragrance Association (IFRA) and RIFM have developed the fragrance industry’s self-regulatory safety program with the development of IFRA Environmental Standards for both risk and hazard in 2008. Fragrance material risk assessments for these Standards are incorporated in the Research Institute for Fragrance Materials’ (RIFM) testing program in coordination with its Expert Panel. To identify materials for risk assessment refinement, fragrance materials were screened using the RIFM Environmental framework and 2008 IFRA volume of use survey as reported for both Europe and North America. The Framework for this evaluation was published in Environmental Toxicology and Chemistry (Salvito et al., 2002, 1301-1308). In addition, hazard assessment on these materials was also performed and reviewed. As a result nearly 3,000 materials were screened with preliminary risk quotients estimated to rank materials for risk assessment refinement in an effort to provide greater transparency to the IFRA Environmental Standards. RIFM reports the most recent results of these additional tests (for both risk and hazard assessments) at both the annual SETAC NA and Europe meetings. These studies include persistence testing (ready biodegradation tests and die-away studies), bioaccumulation, and acute and chronic aquatic toxicity. Incorporating these new data in a second tier risk and hazard assessment for these materials will also be presented.

MO454 Comparison of different sampling techniques for the identification fire effluents from low-density polyethylene burning

A. Badjah, King Fahad Security College / Forensic Science Department; A.A. Stec, University of Central Lancashire / Centre for Fire Hazards and Science, School of Physical Sciences and Computing; Y. Badjah- Hadji- Ahmed, King Saud University / College of Science, Chemistry Department; R. Hull, University of Central Lancashire / Centre for Fire Hazards and Science, School of Physical Sciences and Computing.

High amounts of various polymers are being used in many fields with numerous benefits. However, their great ability to ignition and rapid flame spreading make these materials dangerous for human life and properties due to the release of highly toxic combustion products. The present work aims to investigate several methods of sampling and analysis of polycyclic aromatic hydrocarbons (PAHs) produced by controlled burning of low-density polyethylene (LDPE) using a toxicity tube furnace. Five different sampling methods were used: solid phase micro extraction (SPME), syringe, tedlar bags, sorption tubes, and gas-solution absorbers. The produced hydrocarbons were analysed by gas chromatography coupled to mass spectrometry with and without pyrolysis. The analysis of PAHs released from polyethylene combustion showed that emissions with a potentially negative impact on the human health and the environment are produced in significant concentrations. Among the tested techniques, the most convenient sampling method was that using syringe with a glass vessel which allowed detection of the highest amount of PAHs at both 800 and 600°C, then followed by SPME. On the other hand, the use of gas-solution absorber (midget impinger) showed poorer results. Regarding the use of tedlar bags and sorption tubes, they did not give satisfactory results. Several carcinogenic or possibly carcinogenic compounds were identified in the combustion products, such as benzo(a)pyrene and acrolein.

MO455 PbTk modelling of super-hydrophobic chemicals

W. Lietzsch, K. Goss, Helmholtz centre for environmental research - UFZ / Analytical Environmental Chemistry

It is a widespread opinion that super-hydrophobic chemicals are not taken up by fish [1–3]. But so far, we haven’t seen sufficient evidence why they should not cross membranes or aqueous boundary layers, although these processes might be kinetically slow. Super-hydrophobic chemicals are very challenging for controlled exposure experiments. Here we use the few existing data points of a fish feeding study with Dechlorane (log Kow (estimated) = 11.6) with our recently published PbTk model, Tk-fish, to shed more light on this issue. We first validated the oral uptake-pathway in our model and found that facilitated transport via albumin and bile micelles through the aqueous boundary layers must accounted for, for hydrophobic chemicals such as HCB in order to get correct results. Subsequent simulations with the super-hydrophobic chemical Dechlorane revealed that for an oral uptake route the diffusive transport through aqueous boundary layers in the gastro-intestinal tract and in the blood is indeed the limiting process. Good agreement of the predicted model results with measured values indicates that there is no principal hindrance for the oral up-take of super-hydrophobic chemicals. The results also indicate that it would take roughly 2 years or more for a steady state to be established which is too long for an experimental exposure study. 1. Dyer SD, Bernhard MJ, Cowan-Elisberry C, Perdu-Durand E, Demmerle S, Cravedi J-P. 2008. In vitro biotransformation of surfactants in fish. Part I: linear alkylbenzene sulfonate (C12-LAS) and alcohol ethoxylate (C13EO8). Chemosphere. 72:850—862. 2. Sakuratani Y, Noguchi Y, Kobayashi K, Yamada J, Nishihara T. 2008. Molecular size as a limiting characteristic for bioconcentration in fish. J. Environ. Biol. 29:89—92. 3. 2016. Guidance on Information Requirements and Chemical Safety Assessment, Chapter R.11: PBT/vPvB assessment Draft Version 3.0,European Chemicals Agency, Helsinki. https://echa.europa.eu/documents/10162/23047722/fr_csa_r11_pbt_peg_en.pdf/dd ac9031-du4-a495-9ecf-3738162ba4e8

Migratory bird species at risk - the role of pesticides and other chemicals (P)

MO456 Main scientific gaps in knowledge of risk from pesticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions

C.A. Bishop, Environment and Climate Change Canada / Wildlife Research Division

MO457 Main scientific gaps in knowledge of risk from rodenticides to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions

P. Berny, VETAGRO-SUP / Toxicology

MO458 Main scientific gaps in knowledge of risk from Pb ammunition and shot to [migratory] wildlife globally, and potential contribution of WTIG to CMS questions

R. Cromie, Wildfowl & Wetlands Trust

MO459 Main scientific gaps on knowledge of NSAIDs [migratory] wildlife globally, and potential contribution of WTIG to CMS questions

M. Taggart, University of the Highlands and Islands / Environmental Research Institute

MO460 Main scientific gaps on knowledge of deliberate poisoning to [migratory] wildlife globally

M. Odins, Independent Environmental Services Professional

Big data analysis in ecotoxicology: how to get new information out of existing data? (P)

TU001 Holistic evaluation of long-term field effect earthworm studies with the fungicide Boscalid

F. Slaab, BASF SE; J. Roembeck, S. Jaensch, ECT Ökotoxikologie GmbH; P. Kabouw, BASF France S.A.S.

In order to place a plant protection product on the market, the product and its active substances need to demonstrate an acceptable risk to earthworm communities. The current European risk assessment scheme follows a tiered approach using worst case environmental concentrations and endpoints from earthworm reproduction laboratory studies in tier 1. For the active ingredient Boscalid no risk to earthworms has been identified based on the chronic laboratory studies provided by BASF to EU registration authorities. However, for one of the formulated products containing Boscalid the tier 1 assessment did not allow to exclude a potential
long-term risk to earthworms in the field. Therefore, a comprehensive field study program was conducted in different crops and field sites in Germany between 2000 and 2010. The study program went beyond regulatory requirements and comprised 6 independent long-term field studies that ran up to five years and were accompanied by a comprehensive residue analysis program. The number of earthworm field data generated is - to our knowledge - one of the highest ever collected for one plant protection product. We evaluated the extensive data set using a "holistic" approach putting representativeness/comparability of examined earthworm communities, site- and soil properties of the different locations as criteria in the analysis. Based on these criteria a statistical assessments of representative and comparable earthworm communities in relation to the field exposure were conducted. The assessment revealed that – using data from representative and comparable study sites - there was no concentration related effect of a five-year use of the product regarding diversity and abundance of different earthworm communities.

TU002 Contextualising statistically significant differences observed in mesocosm studies using historical control data

F. Joyce, Cambridge Environmental Assessments; H.S. Schuster, Cambridge Environmental Assessments (CEA) / Aquatic Ecotoxicology

Mesocosms (which aim to replicate communities residing in edge-of-field waterbodies) are used as part of the higher tier aquatic risk assessment for plant protection products (PPPs) in the EU registration process. When setting up mesocosm studies, care should be taken to standardise communities present in each replicate to reduce variability and maximise statistical power; indicated by minimum detectable differences (MDDs). However, being dynamic and complex systems, variability can often still occur between replicates, which can affect the reliability and interpretation of the results. Statistically significant differences can occur due to natural variability rather than biologically relevant effects, but determining if these differences result from real chemical effects can be challenging. One option is to contextualise the experimental results from a single study using available historical control data; this is an approach often used for laboratory studies performed under standard conditions. It is, therefore, proposed that this approach can be extrapolated to mesocosm studies, given that they are also performed under standardised conditions as much as possible. Cambridge Environmental Assessments (CEA) have a wealth of control data from historical mesocosm studies, with samples collected in spring, summer and autumn, thus capturing the variability in population and community dynamics over multiple years and seasons. Here we present our review of this historical control data, and how this provides a baseline to aid interpretation of results from individual studies, allowing an assessment of biological relevance and thus the appropriateness of influencing the regulatory acceptable concentration (RAC). When integrated into the aquatic risk assessment, this will represent a realistic worst-case scenario.

TU003 Enhancing the utility of the ECOTOX knowledgebase via ontology-based semantics mapping


The US Environmental Protection Agency’s Ecological Toxicology (ECOTOX) knowledgebase contains more than 30 years of reported single chemical toxicity effects data on aquatic and terrestrial organisms. Approximately 900,000 test results covering more than 11,000 chemicals and 12,000 species are available in ECOTOX. While the database is currently used by many sectors for a variety of purposes, a future goal is to allow for computational modeling of the data to identify novel adverse outcome pathways and networks, and assist in predicting species occurrence and distribution, allowing e.g. the derivation of reference values and answering environmental questions on a larger scale. However, data from different studies are often very heterogeneous because the studies differ in scope, design, and parameters sampled. This makes meta-analysis a challenging task, as database users need to know how to select, combine and process this mixed origin-data. Automation of these tools is a solution to this problem. We present a web application called “Edaphostat”, which is part of the Edaphobase data warehouse (https://portal.edaphobase.org/). Edaphobase combines spatially explicit information on quantities of soil organisms, environmental parameters, and vegetation. The data in the warehouse are coming from a core set of studies. The application provides several steps of data cleaning, formatting, and transformation to make datasets comparable. Preprocessed data are analyzed and the results are visualized as interactive plots and dashboards. The tool depicts species distribution alongside environmental gradients (for example pH and C/N) and habitat parameters (such as soil classes) and species settlement in ecological niches. Edaphostat makes use of the knowledge of the Edaphobase data warehouse and the rich terminology to better focus literature searches when performing automated analysis of ecological data to assess species-specific aetiological preferences and ecological niches.

TU006 Deriving USEtox aquatic freshwater toxicity Effect factors from the REACH database for thousands of chemicals using R-Studio program

J. Hausen, RWTH Aachen University; B. Schulz-Stäcker, M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research

A steadily increasing number of databases in ecotoxicology and ecology combine and manage data from different studies and research programs. Usage of these databases promises new insights in species occurrence and distribution, allowing e.g. the derivation of reference values and answering environmental questions on a larger scale. However, data from different studies are often very heterogeneous because the studies differ in scope, design, and parameters sampled. This makes meta-analysis a challenging task, as database users need to know how to select, combine and process this mixed origin-data. Automation of these tools is a solution to this problem. We present a web application called “Edaphostat”, which is part of the Edaphobase data warehouse (https://portal.edaphobase.org/). Edaphobase combines spatially explicit information on quantities of soil organisms, environmental parameters, and vegetation. The data in the warehouse are coming from a core set of studies. The application provides several steps of data cleaning, formatting, and transformation to make datasets comparable. Preprocessed data are analyzed and the results are visualized as interactive plots and dashboards. The tool depicts species distribution alongside environmental gradients (for example pH and C/N) and habitat parameters (such as soil classes) and species settlement in ecological niches. Edaphostat makes use of the knowledge of the Edaphobase data warehouse and the rich terminology to better focus literature searches when performing automated analysis of ecological data to assess species-specific aetiological preferences and ecological niches.

TU004

ECOTOX Knowledgebase: New tools for data visualization and database interoperability

C. Elonen, U.S. EPA/ORD/NHEERL; J. Olker, C. LaLone, U.S. EPA / Mid Continent Ecology Division; D.J. Hoff, U.S. EPA ORD / Mid Continent Ecology Division; S. Erickson, M. Skopinski, S. Casey, A. Pilli, K.A. Fay, CSRA, Inc. The ECOTOXicology knowledgebase (ECOTOX) is a comprehensive, curated database that summarizes effects data from single chemical exposure studies to terrestrial and aquatic organisms. The ECOTOX Knowledgebase provides risk assessors and researchers consistent information on toxic effects of chemical substances for use in deriving benchmarks and establishing criteria. ECOTOX has the capability to refine and filter data searches by 16 parameters (e.g. Species, Chemical, Effect, Control, Year, etc.) and customize output selections from over 100 data fields. Study details such as species, taxonomy hierarchy, chemical purity, routes of exposure, and all calculated or statistically derived endpoints provided by the authors is encoded in discrete data fields for each test result. During the past 10+ years, ECOTOX has aligned the coding of the aquatic and terrestrial references by the addition of data fields, adapted search terminology to better focus literature searches, and updated search screens. To meet the data needs of 21st century toxicological assessments, new tools have been integrated into ECOTOX to improve data mining capabilities for end users such that environmental regulatory, the regulated industry, and researchers can more effectively and efficiently search and use existing toxic effects data. New data visualization and filtering options have been added to aid in data exploration. Efforts to enhance interoperability with other EPA databases have been employed to assist in efficiently accessing necessary data. New tools and resources will be available in ECOTOX Knowledgebase version 5.0, to be released in FY18.
and toxicity indicators for thousands of chemicals to be used in the USEtox model. The poster presents the methodology applied for the selection of the aquatic toxicity data available in REACH, the set of criteria used to derive various level of quality data to meet the requirement to produced Effect Factors for as many chemical as possible, and the various calculation procedure to derive final chemical effect factors. Correlation between acute and chronic toxicity for thousands of tests, for each considered endpoints was established, as well as the feasibility to calculate effect values based on Species sensitivity distribution. The following final calculation have been performed for thousands of chemicals: - Acute and Chronic species geometric means with standard deviation and number of individual test available per species - Arithmetic average of all the log of the species geometric mean with standard deviation and count of species as well as count of SSD group for each chemical - Biological and Chemical means with standard deviation - Comparison of the chemical toxicity based on the above calculations and chemical ranking based on GHS and CLP.

TU007 Deriving physico-chemical input data for the USEtox model from the REACH database for thousands of chemicals using R-Studio program F. Bignanza, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; S. Proenca, EU Commission Joint Research; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC/ Sustainable Assessment Unit Product Environmental Footprint (PEF) and Organisational Environmental Footprint (OEFF) were born from a core part of the Commission Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” (2013/179/EU). The potential impact of chemicals emitted during the life cycle of a product is assessed via the USEtox multimedia fate model. This model requires for each single chemical dozens of physico-chemical parameters as well as data of ecotoxicity to freshwater aquatic life and terrestrial soil and biota, for each chemical. Correlation with chronic toxicity mean for cancer and no-cancer effects. For PEF/LEP, those data are required for thousands of chemicals using the most up-to-date information. The EU commission Joint Research Centre has obtained from the chemical agency (ECHA) for more than eight thousand chemicals data regarding physico-chemical properties (166/926 test results, as of March 2017) available in the IUCLED 5.5 database. These data have been processed to automatically derive accurate values for six of the physico-chemical properties required by USEtox for fate modelling: Kow, Koc, vapour pressure, water solubility, Henry law constant and biodegradability; in addition, adsorption partition coefficient (Kd) to suspended matter, sediments and soil for inorganic compounds were determined. In order to provide high quality results, criteria were applied for selecting data on the basis of their reliability (assessed by Klimisch scores), purpose and study type. Moreover, other specific criteria were defined for each properties according to the method used, such as experimental condition (temperature and pH). Geometric mean and the coefficient of variation, for their reliability evaluation, of the consistent data selected was performed. A correlation analysis of the results with values previously included in USEtox and with values obtained with computational methods (QSAR/QSPR) was established to assess the quality of this proposed automated approach. A quality levels approach is proposed. This, paired with the abovementioned statistical index, represents a helpful support to the user for evaluating the reliability of each parameter used in the fate model. For chemicals with no available data or not satisfying the minimum quality requirements, physico-chemical properties were derived using in-silico tools (QSAR/QSPR). In particular, OECD QSAR toolbox and the EPIsuite estimation models played a fundamental role for this data gap filling purpose.

TU008 Toward a possible Toxicity Test Battery Integrated Index for Nanomaterials M. Olivieri, University Parthenope; s. schiavo, ENEA CR; s. manzo, ENEA / SSPT-PROTER-BES Nanotechnology is a rapidly expanding field of research continuously producing novel materials with nanoscale properties (nanomaterials, NMs), as result, it is inevitable that NMs will enter the aquatic environment. Usually the ecotoxicological approach is generally based on a battery of bioassays with organisms belonging to different trophic levels, for each of the selected species its endpoints were selected. While these endpoints, taken individually, can indicate the presence of a potentially deleterious effect, it is often difficult to combine these effects into an assessment of the overall status for the selected environment. Therefore is necessary to integrate all results to evaluate the risk for NMs. To synthesize the results obtained with a battery of ecotoxicological tests, different approaches were considered such as Toxicity test battery integrated index (TBI). This index has the advantage to put in evidence the differences between the samples. However there are still some open issues and TBI integration procedure needed to be modified according to testing sample or substance in order to represent the test sensitivity towards the matrixes. In particular, when NMs are investigated also different physic-chemical behaviour and interaction with organisms should be taken into account. Therefore, the aim of this work is to study the suitability of TBI procedure for the NM to determine the needed modification for tailoring the data integration. In particular, we considered metal bearing nanoparticles (NPs) such as TiO₂, SiO₂ and ZnO and a battery of toxicity test with organisms of different biological complexity and representative of different trophic levels with the aim to establish a unique toxicity ranking. From the analysis of the results integration with TBI it could be highlighted that to define the hazard associated with NPs is necessary to tailor the index parameters on specific NMs physic-chemical characterization. Moreover, to make the results more reliable, together with a larger number of tests, a longer testing time for some organisms and other endpoints (genotoxic and cytotoxic parameters) should be utilized.

TU009 Historical analysis of the use of plant protection products in apple orchards (1970-2014): Combining handwritten farmers records with electronic data L. de Bie, Agroscope / Institute for Plant Production Sciences IPS; M. Mathis, J. Stöhrer, Agroscope; O. Daniel, Agroscope / Institute for Plant Production Sciences IPS Plant protection products (PPPs) are used to protect crops against pests and diseases and ensure yields and quality of crops. Because they are biologically active, they can cause negative side effects on the environment or humans. Data-sets on the use of PPP for specific crops over a long time would allow to get a better knowledge on the potential emissions of PPP within the agro-ecosystems. However, the consistent long-term datasets are mostly lacking. In addition, historic farmers’ records are often only available in handwritten paper format. In Switzerland, data on PPP use in apple orchards has been voluntarily recorded by farmers since the 1950-ies, to evaluate farm economics. Up to the 1990-ies, data were only available in handwritten paper format, since 1997 they were collected electronically. In this study, we digitised the handwritten records and combined it with the historical data. We first developed a concept, how the handwritten records can be entered into a database, which contains similar information as the electronic data. We collected data on farms (productivity), apple plantations (year of plantation, size, type, variety), and plant protection measures per plantation (product, dosage, date of application). In We also developed procedures to handle missing data and to detect (and to correct) errors in the indicated dosage or size field. Finally, a dataset of spray sequences in apple orchards over the period 1970-2014 was analysed, regarding the number of treatments per PPP category (e.g. fungicides), the total amount of active ingredients applied per season and PPP category and the ranking of chemical groups per PPP category. While the average number of treatments and the average amount of active ingredients remained within a similar range, major changes were detected in the composition of applied active ingredients. For example, in the 1970-ies and 80-ies, more than 75% of all insecticide treatments were organophosphates. After 1986, organophosphates were quickly replaced by carbamates and benzoylureas, and today only contribute to about 10% of all insecticide treatments. This study illustrates, that for a historic analysis of pollutants it is sometimes unavoidable to first digitise handwritten data. For further historical analysis of historic pollutions it is necessary to digitise all historic records and combined it with the electronic data. In a next step, we will analyse the historic development of ecotoxicological risks of PPP usage in apple orchards. }

TU010 Using long-term datasets to assess the impacts of neonicotinoids on farmland bird populations in the UK over the last 21 years R. Lennon, The University of York / Environment; N. Isaac, NERC Centre for Ecology & Hydrology; R. Shore, Centre for Ecology & Hydrology (NERC); K. Arnold, University of York / Environment; W. Peach, Royal Society for the Protection of Birds; C. Brown, University of York / Environment Department. The use of long datasets is the majority of research regarding neonicotinoids (NNs) has been focused on pollinator species, however, little work has been done to investigate the potential long-term impacts of these pesticides on other taxa, such as farmland birds. Birds can be directly exposed to NNs via two main exposure routes: ingestion of NN-coated grain, or seedlings germinated from coated grain. With bird abundance data, NN usage records and UK cropping data, a poisson log-linear generalised mixed model was used to investigate whether there are any impacts of NN use on farmland bird populations over a period of 21 years. Specifically, the main objectives of this study were to 1) establish whether there is a relationship between species population growth and NN usage in the UK, 2) establish whether species traits, such as body weight and home range are correlated with any effect of NNs on species population growth, 3) use the results to predict the potential (direct) and (indirect) impact of NNs on population growth and thereby understand the potential impact of NNs on population growth. A total of 54 bird species were modelled, for which the estimated effect of NNs on population growth were highly varied. Relationships between the estimated effects and species traits, including hypothesised risk to exposure will be reported. }

TU011 Regression-based models reveal sources of pollutants in Norwegian marine sediments G. Everaert, Flanders Marine Institute / Laboratory of Environmental Toxicology and Aquatic Ecology; A. Ruus, NIVA / NIVA; D. Hjermann, NIVA Norwegian Institute for Water Research, K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences; N.W. Green, NIVA Norwegian Institute for Water Research / marine pollution; S. Boitsov, Institute of Marine Research; H. Jensen, Geological Survey of Norway; A. Poste, Norwegian Institute for Water Research;
Research

We characterized spatial patterns of surface sediment concentrations of seven polychlorinated biphenyls (PCBs), seven polycyclic aromatic hydrocarbons (PAHs), three chlorinated pesticides and five metals in Norwegian waters and Skagerrak. In total, we analysed 5,036 concentrations of 22 chemical substances that were measured between 1986 and 2014 at 333 sampling sites by means of generalized additive models (GAMs). We found that GAMs with organic carbon content of the sediment and latitude and longitude coordinates explained ca. 75% of the variability of the contaminant sediment concentrations. For metals, a predominantly hotspot-driven spatial pattern was found, i.e. we identified historical pollution hotspots (e.g. Surferjord in western Norway) for mercury, zinc, cadmium and lead. Highest concentrations of PAHs and PCBs were found close to densely populated and industrially used regions, i.e. in the North Sea and in the Kattegat and Skagerrak. The spatial pattern of the PCBs suggests the secondary and diffuse atmospheric nature of their sources. Atmospheric inputs are the main sources of pollution for most organic chemicals considered, but north of the Arctic circle, we found that concentrations of PAHs increased from south to north most likely related to a combination of coal-eroding bedrock and the biological pump. The knowledge acquired in the present research is essential for developing effective remediation strategies that are consistent with international conventions on pollution control.

**TU012**

**Application of a ‘weight-of-evidence’ model for assessing sediment quality and associated hazard with offshore gas platform discharging produced water**

A. Torneseny, ISPRAs Centre for Laboratory Networking, Ecotoxicology Area; L. Manfra, R. Di Mento, G. Moltebo, B. Catalano, ISPRAs Institute for Environmental Protection and Research; G. Martuccio, ISPRAs Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; C. Sibbio, G. Chiaietti, O. Faraponova, M. Amici, C. Maggi, G. Romarali, G. Sesta, G. Granato, F. Venti, P. Lanera, S. Menestrina, F. Onorato, G. Grassi, ISPRAs Institute for Environmental Protection and Research

Environmental quality assessments and monitoring plans are key tools to all activities related to potential contamination of ecosystems, including marine systems. Potential effects of oil/gas production activities in Adriatic Sea (Italy) are successfully investigated since 2000 by water and sediment chemical analyses, sediment grain and industrial sites, biogeochemical surveys. Marine sediment around two gas platforms (Central Adriatic region) were chemically characterized by sampling of twenty four stations at increasing distance from the platform-discharge, and in particular four stations, located at 0, 25, 50 and 100 m along the main local current, also for ecotoxicity. Different inorganic and organic contaminants were analyzed in sediment. To assess the effects of pollutants at different levels of trophic web, results of a bioassays battery composed by the main tested species (Vibrio fischeri; Daphnia tertacea; Necora; Tigrigopus fulvus) were considered. Moreover a battery of biomarkers at different biological levels together with biaccumulation of some inorganic and organic contaminants were analyzed in polychaetes (Hediste diversicolor) exposed to sediment under laboratory conditions. A multidisciplinary weight of evidence (WOE) study was carried out, integrating different lines of evidence (LOE) as sediment chemistry, bioaccumulation, biomarkers and ecotoxicity tests for each platform. These LOEs were elaborated within a quantitative WOE model which provides a synthetic hazard index for a comprehensive assessment of hazard associated to potential contaminated sediments. The WOE elaboration allowed to better summarize complex dataset of results, providing a more realistic evaluation of hazard and risk for produced water discharges.

**TU013**

**Utilising biomarkers in a multispecies approach to relate organochlorine exposure and biological effects**

V. Wepener, North-West University - School of Biological Sciences / School of Biological Sciences; S. Vanheusden, University of Pretoria / Zoology; R. Gerber, North-West University / Unit for Environmental Sciences and Management; N. Smit, North-West University / Environmental Sciences and Management

Due to their persistence and global distribution the use of organochlorine pesticides (OCPs) have been banned in most countries around the world. However, in a number of countries, the use of dichlorodiphenyltrichloroethane (DDT) is still allowed. This practice is not without controversy and reports on ecological and human health effects are increasing. The Phongolo River floodplain in north-eastern South Africa is a high risk malaria area where DDT is used as vector control agent through indoor residual spraying (IRS). This region is also regarded as a biodiversity hotspot in southern Africa and concern has been raised regarding the risk posed as a result of the long term use of DDT. Over the past seven year’s studies have been undertaken to determine the degree of DDT exposure in the aquatic ecosystem through analyzing DDT and other OCP bioaccumulation in a number of different aquatic species. Concomitant biomarker analyses were undertaken to determine the biological effect of the DDT exposure. In this poster we collated and integrated the exposure (DDT and HCH bioaccumulation) and effect (biomarker) data of the different studies to test the hypothesis that increased DDT exposure will elicit similar biological responses across species. Bioaccumulation of DDT (and its metabolites) and HCHs were measured before and after IRS application periods in two decapoda, six fish and two amphibian species. Biomarkers of exposure (cytochrome P450 and acetylcholinesterase) and effect (catalse, superoxidase dismutase, malondialdehyde, protein carbonyl, and cellular energy allocation) were analysed in the same organisms. Using principal component analysis and discriminant functional analysis the exposure and effect data were integrated to elucidate the responses of aquatic biota to OCP exposure. Although higher trophic level organisms (e.g. tigerfish - Hydrocynus vitulus and Mugil - slender frog - Mugil cephalus) displayed the highest DDT bioaccumulation there were no distinct biomarker responses evident. When exposure data of another banned OCP, y-Hexachlorocyclohexane, were included in the analysis, significant relationships with cytochrome P450 and lipid energy reserves were obtained. The result therefore indicated that biological responses were not related to DDT but rather to HCH exposure.

**Microbial community ecotoxicity in environmental risk assessment and ecosystem monitoring (P)**

M. Simonin, Duke University / Biology; K.A. Voss, Regis University; B.A. Hassett, J.D. Roca, S. Wang, Duke University / Biology department; C.R. Violin, University of North Carolina at Chapel Hill / Biology department; E.S. Bernhardt, Duke University / Biology department

The advent of high throughput sequencing enabled microbial ecotoxicologists to better characterize the impact of stressors and especially pollution on microbial community structure. However, the overwhelming amount of information generated by sequencing and the high diversity of microorganisms led us to focus our analyses mainly at the community or phylum levels, ignoring all the key ecological knowledge potentially gained at the population level. In this study, we tried to move beyond both ‘omic’ (prokaryotic) displays of microbial community structure. For this experiment, we high-throughput sequencing data by characterizing the response of individual taxa (OTUs) to a multiple stressor gradient and identifying bacterial indicator taxa. Taking inspiration from classic gradient analyses used for macro-organisms in Ecology (Threshold Indicator Taxa Analysis - TITAN, logistic and quadratic regressions), we identified bacterial taxa that presented positive, negative, neutral or subsidy-stress responses to a well characterized urbanization gradient in 41 streams in the Raleigh-Durham area (North Carolina, USA). We used a combination of environmental variables (% development, % forested, sediment Zn concentration, biotic index) that were significantly correlated to bacterial community structure to identify reliable bacterial indicator taxa along this multiple stressor gradient. Using TITAN, we identified more bacterial indicator taxa negatively impacted by urbanization than positively impacted (138 and 56 OTUs respectively). Using quadratic regressions, we found 140 OTUs presenting a subsidy-stress response to the gradient. We observed that two bacterial families were strongly and consistently decreased by urbanization: Acidobacteriaceae (Acidobacteria) with 50% of OTUs identified as pure and reliable indicator taxa and Xanthobacteraceae (Alphaproteobacteria) with 39% of indicator taxa. Positive responders were distributed all over the phylogenetic tree and the family Comamonadaceae (Beta-Proteobacteria) presented the highest number of indicator taxa (14%). We calculated with TITAN that the community-level threshold, indicating the peak along the gradient where the maximum decline in all negative responders happened, was at 12.1% development. This community-level threshold occurred at very low levels of urbanization patterns and expounds the full potential of microorganisms to urbanization and the potential of bacteria to be used in biomonidation or monitoring along with more traditional indexes.

**TU015**

**Diuron sorption in freshwater biofilms: determination of isotherms**

B. HAUZELMET, Istres; T. Grestone, T. Munier, Istres; B. CREBIZZAC, DR BABB

In 2000, the EU Water Framework Directive (directive 2000/06/EC) was implemented with the objective of reaching the good ecological status of rivers. 45 chemicals were indexed as priority including 19 pesticides. The biofilm is at the basis of the trophic chain in aquatic environments and considered as an excellent bioindicator for water quality assessment (Edwards and Kjellunger 2013) because of its ability to integrate contamination (Vercraene et al. 2010). In this study, we used a photosynthesis inhibitor herbicide: diuron, one of the priority substances to the EU Water Framework Directive. Previous experiments carried out in order to characterize diuron bioaccumulation in biofilms, with two different exposure concentrations, suggest that pesticide uptake by microorganisms was not proportional to contaminant concentration in the water. For this experiment, we supposed that diuron absorbed into microorganisms, and in order to confirm this hypothesis, bioaccumulation and toxic impact were simultaneously assessed at the equilibrium. To that aim, mature biofilm previously grown on glass slides
during one month was exposed in channels at 6 increasing concentrations of diuron: 0, 1, 5, 10, 25 and 50 µg.L⁻¹ for two hours, with a flow velocity of 2 cm.s⁻¹. Then, Langmuir isotherm equation (Praus et al. 2007) was fitted to the bioaccumulation data. During the determination of the isotherm, a plateau was reached over 5 µg.L⁻¹ of diuron in the water. This suggested that all absorption sites were saturated, and then diuron concentration in the biofilm became independent of diuron concentration in the water. The fitting of a Langmuir isotherm allowed to estimate a maximal diuron concentration in a Langmuir isotherm constant of 0.378. Photosynthesis inhibition was correlated (R²=0.75) to diuron concentration in the water. The data did not clearly highlighted a relationship between bioaccumulation and photosynthesis inhibition. This study establishes that diuron bioaccumulation in biofilm is nonlinear, and allows to calculate the equilibrium and the maximal capacity of the biofilm regarding diuron uptake. These two constants can be used to further prediction of diuron bioaccumulated in biofilm from concentration in the water. The innovative coupling of toxicokinetic and toxicodynamic approaches would provide original information about behaviour impact and indirect impact in periphytic microorganisms.

**TU106**

New insights into the biotransformation of sulfurluramid: role of ammonia oxidizing bacteria and community shifts

T. Yin, National University of Singapore / Civil and Environmental Engineering; Y. Yang, S. Te, National University of Singapore; K. Glin, National University of Singapore / Civil & Environmental Engineering

Emerging organic contaminants (EOCs), such as perfluoralkyl and polyfluoroalkyl substances (PFASs), are ubiquitously detected in the environment and have raised increasing concerns due to their adverse effects on ecosystems and humans. N-ethyl perfluorooctane sulfonamide (N-EtFOSA), belonging to PFASs, is used as the active ingredient in the pesticide, Sulfurluramid, which is particularly important in the control of leaf-cutting ants in some developing countries. Previous studies have investigated the biotransformation of diuron in sludge, marine sediments and soil. However, little information is available on the contributions of different microbes to the biotransformation of N-EtFOSA. This study used Allotriahe (ATU), an inhibitor of ammonia monooxygenase (AMO), to investigate the relative contributions of ammonia oxidizing bacteria (AOB) and other members to N-EtFOSA biotransformation and find potential N-EtFOSA degraders by analysing the microbial community shifts. In the reactors with ATU addition, N-EtFOSA was degraded faster with an apparent half-life of 1.3 days, which indicated that ATU had actually enhanced the biotransformation of N-EtFOSA. This implied that AMO was probably not involved in the biotransformation of N-EtFOSA, and thus the inhibition of AMO by ATU had no adverse effect on the biotransformation. ATU-treated sample was more diverse with a Shannon index of 4.04 while that of the ATU-untreated sample was 2.43. The abundance of Candidatus Protochlamydia increased significantly in the ATU-treated sample, which suggested that this genera could be a potential degrader for N-EtFOSA. Future work needs to determine the genes involved in the biotransformation process using metagenomics and metatranscriptomics.

**TU107**

How can three herbicides impact the fatty acids of the freshwater diatom Gomphonema gracile?

F. Demaële, IRSTEA Bordeaux / Irtemmer Nantes / EPOC (LPTC) / UR EABX; M. LE GUEARD, LEB AQUATINA TRANSPER-ADERA / LEB AQUATINA TUB; B. Delest, IRSTEA Bordeaux / UR EABX; P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; N. Mazzella, S. Morin, IRSTEA Bordeaux / UR EABX

Fatty acids are essential elements for the structure of biological membranes and for the storage of metabolic energy. They are used as a source of energy by metabolism at each trophic level, making fatty acids biochemically and physiologically important compounds (Neves et al. 2015). In the trophic chain, many fatty acids are only synthesized by microalgae and bacteria before being transferred via herbivorous invertebrates to fish and ultimately to humans (Arts et al. 2001). For example, highly unsaturated fatty acids (HUA) such as eicosapentaenoic acid (EPA; 20:5) cannot be synthesized de novo or in insufficient proportions by animals hence their energy is obtained by the reduction of the amount of applied fertilizer. Zinc oxide NPs have been largely used nanofertilizers to speedroing crops seem to increase their growth and yield. This increasing use could lead to their introduction in the environment occurring also via unintentionally pathways. Actually, some studies reported ZnO NPs negatively affect soil microbial activities and consequently the biogeochemical cycles. These effects could be evidenced by assessing metabolic profiles of culturable, aerobic, heterotrophic microorganisms (Biolog). BiologEcopeate was successfully used to detect short and long-term changes of functional diversity of soil microbial communities. This method was based on the determination of the oxide profiles related to several different carbon sources. This study aims to investigate the changes in the metabolic profile of culturable soil microbial communities pertaining to Pseudomonas putida subsp. subsp. putida (6.25%, 12.5% and 25%), Lepidium sativum (50%). At time 0, 15, 30 days fresh soil samples were assessed by using the BiologEcopeate approach. The occurrence of the microbial oxidation of each BiologEcopeate™ C source was calculated as probability ‘p’ on a binomialal data in order to identify the treatments able to preserve the highest possible oxidizing activity of C substrates and those negatively affecting ZnO NPs-nanofertilizers were more toxic than fertilizers with ZnO in bulk form, for algal growth, instead for plants, the effects of ‘ZnO-nanofertilizers’ depended on the fertilizer type: only F1 + ZnO NPs resulted more stimulating than F1 + ZnO Bulk. Preliminary Biolog results seemed to highlight that the microbial community
was mainly affected by ZnO NPs. The integration of the classical ecotoxicology with BiologEcoplate approach could represent a good strategy to establish the environmental risk related to the use of nanofertilizers. Keywords: microbial community, ecotoxicology, nanofertilizers

TT020
Environmental factors-regulated disease dynamics of tilapia lake virus (TilTV) transmission in farmed tilapia ponds
T. Lu, Nation Taiwan University / Department of Bioenvironmental Systems Engineering; Y. Yang, National Taiwan University / Bioenvironmental Systems Engineering; H. Lin, National Taiwan University; C. CHEN, National Taiwan University / Bioenvironmental Systems Engineering; W. Chen, Kaohsiung Medical University / Dept Biomedical Science and Environmental Biology; C. Liao, National Taiwan University / Department of Bioenvironmental Systems Engineering

BACKGROUND: Outbreaks of tilapia lake virus (TilTV) have caused substantial mortalities of farmed tilapia, posing a significant threat to worldwide tilapia industry. Environmental factors controlling TilTV disease dynamics should be clearly elucidated to prevent the potential economic impacts on aquaculture.

OBJECTIVE: The main objective of this study was to make the TilTV disease dynamics by constructing an epidemiological model to implicate aquaculture management among farmed tilapia ponds.

METHODS: The mortality of Nile tilapia infected by intraperitoneal (I.P.) injection with different TilTV dosage were fitted by two-parameter Hill model to estimate median lethal dose (LD50). To explore TilTV highly artificial environmental conditions, sacrificing some of the experimental-susceptible-mortality (SIM) model was applied to describe cumulative mortality data to estimate mortality rate (α), transmission rate (β), and basic reproductive number (R0) for Nile tilapia posed by TilTV under treatment of cohabitation.

RESULTS: In toxicity assessment, LD50 estimate of Nile tilapia infected by I.P. injection with different TilTV dosage was 57127.5 TCD50 mL−1. Nile tilapia were significantly inhibited biomass production of both green algae in the standard OECD medium (biomass concentrations of 50 mg/L throughout. TiO2 and CuO nanoparticle toxicity in four aquatic species

TT021
Natural organic matter alleviates TiO2 and CuO nanoparticle toxicity in four algal species
E. Zellner, V. Aruoja, National Institute of Chemical Physics and Biophysics / Laboratory of Environmental Toxicology; K. Olli, University of Tartu / Institute of Ecology and Earth Sciences; A. Kahr, National Institute of Chemical Physics and Biophysics / Laboratory of Environmental Toxicology

Although the knowledge concerning synthetic metal nanoparticle (NP) effects on aquatic organisms has improved during the last decade, most research has been conducted on TilTV highly artificial environmental conditions. Sacrificing some of the experimental reproducibility to obtain more environmentally relevant data, we studied the 72-hour effects of uncoupled CuO (CuSO4 as ionic control) and TiO2 NPs on two endpoints, biomass production and photosynthetic maximum quantum yield (Fv/Fm), in nutrient-adjusted natural water (ANW) and the OECD201 standard medium, using four freshwater species from three major algal groups: green algae (Chlamydomonas reinhardtii), diatoms (Synechocystis sp), and cyanobacteria (Synechocystis sp). Metal toxicity on both parameters at 72 h was reduced in ANW in all algal species except the cyanobacterium, presumably because of natural organic matter (NOM) binding to the NPs and solubilized ions. The biofilm-forming diatom was most resistant to NPs when incubated in ANW, whereas both the diatom and the cyanobacterium were not inhibited by TiO2 at concentrations up to 100 mg/L. TiO2 significantly inhibited biomass production of both green algae in the standard medium (EC50: 143-1 mg/L), but only R. subcapitata was inhibited in ANW (EC50 31 mg/L). TiO2 NPs did not significantly inhibit Fv/Fm of any species in either medium up to 100 mg/L, indicating a lack of toxic effect on the photosynthetic apparatus. The sensitivity to CuO remained at a similar level in the standard OECD medium (biomass based EC50: 0.2-0.9 mg/L) for all species, but differed over orders of magnitude in ANW (EC50 0.3-16 mg/L). The cyanobacterium, that has the smallest cell of the four tested species, was consistently most susceptible to Cu toxicity. While shedding of Cu ions from particles explained Cu toxicity, TiO2 effects were at least in part due to observed cell diatom heterogametization. Overall, Fv/Fm was a less sensitive toxicity endpoint than biomass, but the two parameters were strongly correlated (Spearman’s ρ=0.6-0.9) when toxicity was evident, again proving Fv/Fm as a rapid method for toxicity detection. The observed discrepancies in toxicity indicate that using different model organisms, experimental endpoints and conditions could provide valuable information about the behavior of emerging contaminants in the environment, thus improving the quality of risk assessment.

REFERENCES: Documented, while knowledge about effects of other nanoparticles is scarce. In a recent study the antithistamine fexofenadine was shown to impact the microbial decomposition of plant detritus, however, the mechanism basis for this remains unexplored. We therefore conducted a microbial manipulation experiment, where two microbially colonized two plant substrates (i.e., black alder leaves and hay). Both precolonized substrates were subsequently exposed towards fexofenadine at concentrations of 0, 2, and 200 µg/L. Replicates (n=10-15) were harvested after 15 and 30 days. Substrates were used to determine mass loss or preserved to estimate microbial communities’ structural or functional composition including fungal biomass, sporation of aquatic fungi, bacterial abundance, fungal and bacterial DNA, enzyme activities. Furthermore, water samples were analyzed for dissolved organic carbon (DOC) quality or preserved to analyze total organic carbon. After 15 days of exposure, there was a tendency towards reduced decomposition of black alder leaves (~40%) in both fexofenadine treatments, while after 30 days, decomposition in the 200-µg/L treatment was increased by ~45% (but both not significantly different from the control). On the contrary, the decomposition of hay tended to be increased by fexofenadine exposure after 15 days. After 30 days no differences could be observed among fexofenadine treatments for hay, while generally more hay was decomposed than black alder. Accordingly, in water samples of the two substrates, substantial differences in the DOC quality were observed. Furthermore, fexofenadine exposure led to changes in functional parameters to an increased proportion of microbially-derived DOC. These observations suggest that the microbial communities’ structure and/or functional composition differ between the two tested substrates as well as among the antihistamine treatments. Moreover, potential implications in carbon and nutrient fluxes in exposed systems are indicated as the detected alterations in DOC quality may affect planktonic decomposer communities that are involved in DOC’s microbial processing in surface waters. To gain an in-depth mechanistic understanding of the observed effects, we are currently analyzing samples related to microbial community structure and functioning.

TT024
Innovative tools and metagenomics for the monitoring of rivers and lakes: the European project INTCATCH
M.D. Serimshaw, Brunel University / Institute for the Environment; S. Marcheggiani, Italian Institute of Health ISS / Environment Health; M. Caere, Italian Institute of Health ISS; O. Tcheremesskia, Italian Institute of Health ISS /
sources of biochemicals. Microorganisms are also primary targets for chemicals, which can lead to structural and functional alterations of microbial communities, with potential negative consequences for ecosystem functioning and environmental selection of antimicrobial resistance. Hence, a microbial community-level perspective in ecotoxicology is more important than ever. In this presentation we will first provide an overview on the current status of microbial community ecotoxicology research, in aquatic and terrestrial ecosystems, and to which extent this field is considered in environmental risk assessment and management. We will describe the challenges within both aquatic and terrestrial microbial community ecotoxicology. Finally we will discuss future research directions in microbial community ecotoxicology to accurately assess and predict impacts of chemicals on ecosystems, and to develop specific response indicators of chemical exposure and effects.

TU027 Hydrodynamic conditions alter the tolerance of biofilm communities towards chemical stress
B.H. Polst, Helmholtz Centre for Environmental Research - UFZ / Department of Bioanalytical Ecotoxicology, F. Larra, Helmholtz Center for Environmental Research - UFZ GmbH; S. Lips, Helmholtz Centre for Environmental Research UFZ / Department of Bioanalytical Ecotoxicology; C. Anlanger, U. Risse-Buhl, M. Weitere, Helmholtz Centre for Environmental Research UFZ / Department of River Ecology; M. Schmitt-Janssen, UFZ - Helmholtz Crc Environm. Research / Department of Bioanalytical Ecotoxicology

Biofilms in rivers are complex communities built of bacteria, fungi, algae and protozoa embedded in a matrix of extracellular polymeric substances (EPS). They are important hotspots for biogeochemical processes in aquatic systems. A variety of stressors can potentially affect the structure and function of biofilms. Therefore their tolerance to one stressor may be influenced by former exposures to another stressor. Community composition and physical structure is influenced by different hydrodynamics. Even though single stressors are demonstrated to decrease with higher mean flow velocity and turbulence, the cell-to-EPS ratio increased. As the EPS content of a biofilm may influence the bioavailability of toxicants, differences in community tolerance towards herbicides are expected for biofilms grown under variable flow conditions. Still, the interactive effects of hydrodynamic growth conditions and herbicide tolerance are lacking. Using an artificial flow-through channel and water from the River Selke (Elbe catchment, Germany), we created heterogeneous flow regimes and related biofilm community structure and function to different mean flow velocities and values of turbulent kinetic energy. Taking the biofilms grown under such controlled hydraulic conditions, herbicide tolerance towards prometryn was tested according to the PVC test method. Focusing on the potamagathic freshwater canker fungus, we 1) investigated the algal structure, function and herbicide tolerance under different near-bed turbulences (diatom composition, photosynthesis) and 2) assessed the role of EPS in stressor interactions. The relevance of EPS content in combined stressor interactions was confirmed by using artificial EPS and algal cultures.

TU028 Does fungicide exposure alter interspecific relationships of aquatic fungi during leaf decomposition? - A case study using species-specific qPCR assays
N. Roedig, University of Koblenz-Landau; P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; J.P. Zubrod, D. Englert, University of Koblenz-Landau / Institute of Environmental Sciences; M. Korsch, University Koblenz-Landau / Institute for Environmental Sciences; C. Schäfer, University Koblenz-Landau / Institute for Environmental Sciences; M. Bundeschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment

Aquatic hyphomycetes, a polyphyletic group of freshwater fungi, are considered key players in leaf litter breakdown, an important ecosystem function in aquatic systems. Structural implications of anthropogenic stressors in aquatic hyphomycete communities have mainly been analyzed using spore morphology, which does not allow assessing direct responses on species-specific abundance and performance under stress. Therefore, we performed a microcosm experiment in which we related the structure of a model fungal community (consisting of 10 species from different fungal communities, we 1) investigated the algal structure, function and herbicide tolerance under different near-bed turbulences (diatom composition, photosynthesis) and 2) assessed the role of EPS in stressor interactions. The relevance of EPS content in combined stressor interactions was confirmed by using artificial EPS and algal cultures.

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resulted in an up to 99% reduced abundance of the inferior species. Species interactions were largely unaffected by fungicide exposure as dominant species where generally those identified as tolerant towards fungicide exposure. However, qPCR results revealed that one of the two sensitive species exhibited a significantly increased DNA yield in presence of the other one at field-relevant fungicide concentrations (5 µg/L). Species-specific qPCR assays proved to be a valuable tool for assessing ecotoxicological effects on well-established ecological interactions within aquatic hyphomycete communities. In the future, this technique might become an asset in aquatic risk assessment and environmental stress monitoring.

TU029 Cyanobacterial Bloom in the Lake Varese: Characterization of Microbial Communities based on Metagenomics analysis
D. Conduto Antonio, European Commission Joint Research Centre / Directorate Space, Security, and Migration; R. Loos, I. Sansevenario, European Commission Joint Research Centre; A. Lahm, Bioinformatic consultant; A. Beghi, F. Pandolfi, ARPA Agenzia Regionale per la Protezione dell’Ambiente della Lombardia; P. Genoni, Lombardy Regional Environmental Protection Agency; D. Napierska, T. Lottici, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

The increasing anthropogenic eutrophication and climate changes are contributing to the intense proliferation of cyanobacteria in waterbodies so causing a phenomenon known as bloom which may compromise the quality of drinking and recreational water. The dynamics of bloom events are not yet fully understood, however it is scientifically accepted that external factors such as water temperature, nutrient concentrations and light intensity, may influence the potential of a bloom. Our study focuses on the relationship between environmental factors and the composition of the microbial community of the lake Varese (Italy) for a period of several weeks before and after the bloom event. Sampling campaigns were performed on a weekly basis. Water samples were collected from the depth region of 0.5 to 3 m (subsequent to the Secchi disk depth, 13 m (MESO) and 2.5 times the Secchi disk depth measured in situ on sampling day (2.5x SECCCHI)). The samples were characterised for their chlorophyll a content, nutrients, cyanatoxins and genomic DNA was extracted for metagenomics. Purified DNA samples were subjected to 16S sequencing (variable region V3-V4) and for shotgun analysis. All 16S samples were MiSeq sequenced as 2x250bp paired reads, the corresponding shotgun samples as 100bp paired reads. Shotgun analysis was performed for sample collected from 31/8/2016 until 5/10/2016 and only for the EPS and 2.5x SECCCHI. The results showed that a peak of cyanobacteria was observed around 14/9/21.9 in the EPS (E) samples consistent with the high observed concentration of chlorophyll a. The lowest abundance of the cyanobacteria was in the MESO samples. A significant alteration of the overall bacterial composition was also observed for protozoa and actinobacteria. Our results suggest that the major differences in bacterial community composition during the bloom are concentrated in the SECCCHI depth region while composition of the EPS zone is more or less constant. Cyanobacteria were found highly abundant in Lake Varese and are therefore likely responsible for the bloom. This hypothesis is also supported by the cyanatoxin data although comparatively lower concentrations would be recommended in order to discard a possible contribution of phototrophic eukaryotes.

TU030 Following copper bioaccumulation and internalization during freshwater biofilm development using stable Cu isotope
A. Dalmasso, Irstea Lyon / Unité de Recherche Milieux Aquatiques, Ecologie et Pollutions (MAEP); J. Gahou, Irstea Lyon-Villeurbanne; m. masson, c. brosse, Irstea Lyon; B. Volat, Irstea Lyon-Villeurbanne; C. Bonnineau, Irstea Lyon; S. Pesce, Irstea Lyon-Villeurbanne / Microbial ecology of anthropised river systems; M. Coquery, Irstea Centre de Lyon - Villeurbanne / Unité de Recherche Milieux Aquatiques, Ecologie et Pollutions (MAEP)

In small streams, microbial communities form river biofilms attached to solid substrates by producing extracellular polymeric substances (EPS). This matrix may act as a protective layer by limiting cellular contact with surface water contaminants. Thus, several studies have suggested that during biofilm growth, biofilm and EPS matrix thickness could limit cellular bioaccumulation. To test this hypothesis in freshwater ecosystems, a captive experiment was carried out. Periphyton was exposed to Cu during 35 days at different concentrations. A sequential extraction was then applied to recover Cu from the colloidal and capsular EPS fractions. The resulting pellet was mineralized to determine Cu concentrations in the intracellular fraction. Copper concentrations and isotopic ratios were determined by ICP-MS in water collected at various times of the experiment and after 20 and 40 days in the different fractions of the biofilm. The results showed constant dissolved Cu concentrations during the two exposure periods (~7 µg/L); while isotopic ratios 65Cu/63Cu widely differed between the first (2.23) and the second phase (0.25) of exposure.

Bioaccumulation levels of Cu in the young biofilm (20 days) were similar between the colloidal, capsular and cellular fractions. Finally, the isotopic approach showed that after 40 days of exposure, the isotopic ratios in the three fractions of the biofilm were similar to the ratio in water of the second phase of exposure (~0.25). These results suggest (i) an intense and rapid renewal of the biofilm and of the bioaccumulated Cu and (ii) that Cu concentrations in a mature biofilm at a given time reflect the last period of exposure. In addition, strong differences in isotopes were very low, a significant difference of isotopic ratios between the EPS fraction (0.25) and the cell fraction (0.35) confirms the potential protective function of the EPS matrix.

TU031 Zirconium impact on freshwater periphytic communities
C.N. Doose, INRS - Centre Eau Terre Environnement; S. Morin, Irstea Bordeaux / UR EABX; C. Fortin, Institut national de la recherche scientifique Centre - Eau Terre Environnement

The growing world demand for metals increases metallic element mobilization in aquatic systems. Although the effect of metals on freshwater ecosystems is well documented, studies on the impacts of tetravalent Zirconium (Zr) are a tetravalent non-radioactive element for which the global demand is increasing in the last decades. Benthic microorganisms community (periphyton) have shown good potential as a biomonitoring tool to assess metal exposure of aquatic organisms. In this work, the effect of Zr on periphyton biodiversity and biochemistry was investigated to apply this tool to zirconium and other tetravalent metals contamination assessment and to better understand their potential impacts on aquatic ecosystems. Glass slides were immersed in a pond in Cestas (near Bordeaux, France) for one month to be colonised by periphyton. They were distributed in 3 aquaria containing a synthetic culture medium (Dauta, 1982) and effective concentrations of 0.2 ± 0.1 nM (C0), 0.5 ± 0.3 nM (C1) or 2.9 ± 0.3 nM (C2) of Zr (n=3). One slide per section was sampled after 1, 2 and 4 weeks of exposure. Biofilm was obtained and analysed using mass spectrometry (MALDI-TOF), photometric activity, microscopic zirconium identification, polysaccharide and protein contents. Biomass, proteins, polysaccharides and diatoms abundance increased significantly showing the growth of the biofilm during the experiment. No significant Zr exposure effects were observed on biomass, proteins, polysaccharides contents but their productions appeared to be slightly lower in C1 and C2 at t2 and t4. Diatoms growth rate in the C2 condition was significantly lower than in C0 and C1. Results obtained by pigments fluorescence measurements showed significant cyanobacteria decrease in the C2 condition over the exposure time as well as the brown algae between t2 and t4. Principal response curve (PRC) analysis showed significant changes over time of microeukariae composition benchmarking the reference (C0) and the C2 condition. Giliates were less impacted by Zr exposure than flagellates which tended to disappear in the C2 condition. Biofilm microorganisms play a wide role in major ecosystem processes. Regarding these results, Zr exposure can impact the periphyton microorganisms composition which could disturb periphyton key functions. A better understanding of effects of metals on microeukariae would improve risk assessment of metalic exposure in aquatic ecosystems.

TU032 DNA metabarcoding demonstrates effects from copper at environmental concentrations on microbial diversity in marine periphyton biofilms
N. Cerrella, University of Gothenburg, Sweden / Biological and Environmental Sciences; J. Yang, Nanjing University / State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment; H. Kronenberger, T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; X. Zhang, Wisconsin Department of Natural Resources / State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment; M. Eriksson, Chalmers University of Technology / Department of Shipping and Marine Technology

Copper pollution is common in coastal areas. In particular, the use of copper-based antifouling paints on ships hulls elevates copper concentrations in these environments. This study assesses the effects of dissolved copper on community structure and function of marine periphyton biofilms. Microbial diversity and community function were assessed using high-throughput sequencing targeting prokaryotic and eukaryotic organisms, respectively. Community function was studied as impacts on algal biomass, photosynthetic pigment profiles and primary production. Additionally, we studied Pollution-Induced Community Tolerance (PICT) using photosynthesis as the endpoint. Periphyton was exposed for 18 days to five copper concentrations, between 0.01 and 10 µM, in a semi-static test. The exposure sequencing yielded 7.1 and 5.7 million high quality 16S and 18S reads, and the average numbers of 16S and 18S Operational Taxonomic Units among the samples were 9405 and 1242, respectively. Analysis of Unifrac distances showed that copper significantly changed the eukaryotic community structure at concentrations as low as 0.01 µM. The prokaryotic community structure was changed at slightly higher concentrations (0.06 µM). A total of 23 taxa, including species within the Proteobacteria_Bacteroidetes_ Stromonelletes and Hacrobiota classes, were identified as particularly sensitive to copper. Algal biomass, photosynthetic pigment profiles and primary production, were reduced at Cu concentrations of 0.06 µM and higher. PICT measurements confirmed that copper
induced community tolerance in exposed communities. Taken together, these findings indicate that negative impacts from copper might be common in coastal ecosystems.

TU033
A Time-series Study of Soil Microbial Community Compositional and Functional Shift in Biodiesel vs. Petrodiesel Contaminated Soils
D.L. Carr, Texas Tech University / Biological Sciences; M. Dong, Texas Tech University / Biological Science

The spilt of petrodiesel on land can irreversibly damage the soil ecosystem, and there are limited studies comparing petrodiesel and biodiesel impacts on soil microbial communities. Biodiesel has been considered as a viable substitute for petroleum, however, there is little evidence which indicates biodiesel is more microbial friendly than petrodiesel is conclusive. Previous studies of soil microbial community on contaminated sites revealed to fail the dynamic changes of soil microbial communities. This laboratory study compared the effects of petrodiesel and three types of biodiesel on soil microbial communities in sandy loam soils. Contaminated soil samples were investigated at day 0, day 7 and day 180 to evaluate their effects on the composition and function of soil microbial communities. Biolom EcoPlates™ were used to test the microbial community functions based on carbon utilization while soil microbial composition were addressed by 16s rRNA gene sequencing of V3-V4 regions. Results suggested that biodiesels were not statistically different from petrodiesel in terms of their adverse impacts on soil microbial communities. In conclusion, our results suggested that biodiesels not be automatically considered conditions under different pedo-climatic conditions in agricultural area. Pesticides, pharmaceuticals and metals concentration were measured by HPLC-MS or ICP-MS. PCA, ANOVA and co-inertia analysis results showed that algal growth was different between freshwater and groundwater. As expected, the green alga was sensitive to alkalinity, SO₂, O₂ and pH whereas diatoms were positively sensitive to silica concentration and dissolved organic carbon (DOC). Besides, the green alga responded positively to the metals Co and Ni and negatively to S-triazines, terbutylazine and their metabolites. At last, the pharmaceuticals benzoylecgonine and carbamazepine/irbesartan/valsartan were measured in intertidal sediment, M. galloprovincialis and B. lagenaria pellucida by an automated fluorometric microplate assay to evaluate the groundwater and river quality in four riparian wetlands in the south-west of Europe (Monbèqui (France), Saragossa (Spain), Bidasoa (Spain) and Toledo (Spain)). Four campaigns of water sampling were realized during contrasted hydrological conditions in agricultural area. Pesticides, pharmaceuticals and metals concentration were measured by HPLC-MS or ICP-MS. PCA, ANOVA and co-inertia analysis showed that algal growth was different between freshwater and groundwater. As expected, the green alga was sensitive to alkalinity, SO₂, O₂ and pH whereas diatoms were positively sensitive to silica concentration and dissolved organic carbon (DOC). Besides, the green alga responded positively to the metals Co and Ni and negatively to S-triazines, terbutylazine and their metabolites. At last, the pharmaceuticals benzoylecgonine and carbamazepine/irbesartan/valsartan were measured in intertidal sediment, M. galloprovincialis and B. lagenaria pellucida, respectively. Same records for pharmaceuticals were observed for the other three sites, excepted Bidasoa. Both extensive sampling and data analysis makes our approach a new useful bio-indicator for preliminary investigation of groundwater quality in order to predict the best location of quality water for human consumption (ATTENAGUA project).

Can trends in wildlife populations revolutionise our understanding of the impacts of chemicals on the environment? (P)

TU035
Can post mortem data be used to monitor population health in response in the Barn owl?
L. Walker, Centre for Ecology & Hydrology; E.D. Potter, NERC Centre for Ecology & Hydrology / Lancaster; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; R. Shor, Centre for Ecology & Hydrology (NERC)
The Predatory Bird Monitoring Scheme (PBMS: http://pbms.ceb.ac.uk/) is national long-term project that monitors contaminant residues in a range of avian predator species. Each bird that is submitted to the scheme is given a post-mortem examination during which approximately 60 macroscopic observations and measurements are made. The information gathered during this examination could potentially be used to monitor health status of the birds at the time of their death or at a particular stage of their development. Previously we have focused on examining health indicators for the sparrowhawk, Accipiter nisus. We were able to establish baseline “norms” for indicators that could be broadly categorised as indicators of change in: (i) population demography because of altered recruitment, survival and mortality (measures were sex ratio, proportion of first-year birds, and proportion of deaths from starvation or disease); (ii) change in nutritional status (measures were body weight, fat score, condition index) that may be a pre-cursor for subsequent population impacts, (iii) physiological stress (as measured by heart rate fluctuation asymmetry) that may be an indicator of fitness. In the current study we investigated whether these population health indices could be applied to barn owls, Tyto alba. We were able to establish baseline “norms” in the form of Shewhart charts. For example the mean proportion of birds that were female was 48% with a prediction interval of 38%-59%, and so years in which the prediction interval was outside 38%-59% for the mean proportion female would be considered abnormal and first-year birds could be considered collectively. For many indices females and males needed to be studied separately due to sexual dimorphism. Females had significantly heavier mean body weights than males (287g vs 258g) but there was extensive over lap in the prediction intervals for the two sexes. Prediction intervals for the percentage of birds with low fat deposits were 23-65% and 28-75% for females and males, respectively. The level of kurtosis within 10th primary feather weight precluded this metric from being used to investigate fluctuating asymmetry. This study shows that the proposed population health indices generally can be reported for barn owls. Establishing these population health indices can then be used to provide an early warning of whether chemical or other stressors are affecting the demography of barn owl populations.

TU036
Identifying suitable marine biomonitor in South Africa: Mussels vs Whelks
C. Sparks, Cape Peninsula University of Technology / Conservation and marine ecology; W. Samuels, Cape Peninsula University of Technology / Department of Conservation and Marine ecology
Over the last three decades there has been a significant decline in marine pollution monitoring-related studies in South Africa. Very little research has been conducted to assess the prevalence of imposex in whelks and also very few studies have been conducted on comparisons between contaminants in different marine invertebrates at the same sites. The current study was conducted in July 2017 to compare metal bioconcentration between mussels (Mytilus galloprovincialis) and whelks (B. lagenaria) as well as measure imposex prevalence in B. lagenaria at Bloubergstrand, Granger Bay and Green Point, Cape Town, South Africa. This was done in order to identify suitable bioindicators of ecotoxicity by determining whether the mussels and whelks bioaccumulate metals in the same way and to assess imposex prevalence in whelks (as an indicator of tributyltin contamination). The bioconcentrations of metals (Al, Cu, Zn, Fe, Cr, Mn, Co, Cd, Ni, Mo, Cu and Pb) were measured in intertidal, M. galloprovincialis and B. lagenaria and imposex prevalence recorded in B. lagenaria. Results showed that the highest prevalence of imposex in whelks and metal concentrations were recorded Granger Bay, an area of high boating activity. The most important result was that the whelks had higher bioconcentrations of metals than the mussels at all sites. Identifying biomonitor should be linked to purpose of investigation before selection of species, and mussels have been considered ‘ideal’ bioindicators of contamination in South Africa. Given the ubiquitous distribution of B. lagenaria along the South African coast, which is not the case for M. galloprovincialis which only occurs on the west and south east of the country, the proposal is made that B. lagenaria could be considered as alternative bioindicators of ecotoxicants in the region.

Recent developments in environmental risk assessment for pollinators (P)
TU038
Behavioural effects of imidacloprid, a neonicotinoid insecticide, on bumblebees (Bombus terrestris)
J.S. Paus-Knudsen, University of Oslo / Department of Biosciences; H.A. Sveinsson, University of Oslo / Department of Physics; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences; M. Grung, A. Nielsen, University of Oslo / Department of Biosciences
Bee's are increasingly facing multiple and interacting threats. One of the threats that have received increased attention lately is neonicotinoids: a group of systemic neuro-active pesticides that disturb the transmission of signals in the insect’s nervous system. In just a few years neonicotinoids have become the most widely used insecticide in the world, and protect a variety of crops against invertebrate pest. Despite being used in relatively small quantities, several studies have shown significant effects of neonicotinoids on honeybee (Apis mellifica) and even more so on neonicotinoids in field-realistic does. However, ecological and physiological traits vary among bee species and studies on honeybees may not provide satisfactory predictions for negative effects on other bee species. Using bumblebees, Bombus terrestris, the present study developed a new experimental method to quantify how chronic dietary exposure to the neonicotinoid imidacloprid affects learning, locomotor activity and consequently the ability to forage and thus pollinate in a non-Apis species. Bumblebees were exposed to three different dosages of imidacloprid through artificial nectar (sugar water), ranging from field realistic
levels (1 mg/L and 10 mg/L) to distinctly higher levels (100 mg/L) in a chronic exposure regime, lasting for eight days. To assess whether imidacloprid influences learning, the bumblebees’ ability to discriminate between blue nectar-filled (rewarding) and yellow water-filled (non-rewarding) artificial flowers were tested systematically in a flying arena. The bumblebees were tracked by cameras, allowing for analysis of the flowers choices, locomotor activity and all the flowers visited during numerous, simultaneous foraging bouts. This study shows the successful application of a new method to track bumblebee behaviour. Further, the study shows that learning and locomotor activity are negatively affected, in a dose-dependent manner, when bumblebees are exposed to imidacloprid. Moreover, we show that field-realistic doses of imidacloprid have negative effects on bumblebees.

TU039 Sensitivity of honeybee larvae to PPPs and impact analysis based on EFSA Bee GD * R. Becker, BASF SE Agrarzentrum Limburgerhof; J. Lueckmann, Rifcon GmbH * on behalf of the ECPA NTA & Bee Working Group Based on EU Regulation 1107/2009/EC the current regulatory risk assessment on bees has to address the risk on honeybee larvae or honeybee brood. In July 2013 the European Food Safety Authority (EFSA) published a guidance document on the risk assessment of plant protection products on bees (EFSA 2013). This document is intended to provide guidance for notifiers and authorities in the context of the review of plant protection products (PPPs) and their active substances under Regulation (EC) 1107/2009 (EC 2009). The aim of this study is to compare historical data and give recommendations for future testing (Pistorius et al., 2012, Becker et al. 2014). Despite fulfilling all recommendations, high variability in brood termination and high control mortality is still evident in some of the conducted studies. For those studies data interpretation and conclusions are questionable. According to Wang and Görlich (2017) one reason for the variability of brood termination rates is that the evaluation of brood development is based on a limited, defined number of cells containing eggs. According to their opinion results might be different if all cells would have been chosen. They suggested that it would reduce the uncertainty to a minimum. In this poster the recommendation of Wang and Görlich (2017) is used to find out if uncertainty can be reduced by evaluation of all cells. The brood data used were collected according to OECD 75 during a field trial in Phacelia tanacetifolia (PPC) and field and offfield (PPP) scenarios. Where a substance or use should not pass one of the screening level risk quotients, EFSA offers the possibility for refinement. This study shows the possibility for refinement in a tier I risk assessment. This includes the refinement of exposure estimates from the screening step and also additional exposure routes, such as the exposure to flowering weeds in field margins and adjacent flowering crops. The second objective of this poster is to evaluate the impact of the proposed screening and tier I risk assessments on the pass/fail rate of currently available active substances and formulated products which is an ability of the scheme to correctly identify compounds of potential concern and consequently screen out those of low concern. The aforementioned analysis follows the principles described in the ECPA impact analysis (Miles and Alix 2013) and compared the first approach with the outcome based on laboratory data. in

TU040 Honeybee brood studies according to Oomen and OECD GD 75: Is there a difference of the brood termination rate under semi-field and field conditions* L. Franke, Eurofins Agroscience Ecotox GmbH / Ecotoxicology Field; O. Klein, Eurofins Agroscience Services Ecotox GmbH / Ecotoxicology Field; J. Fricke, Eurofins Agroscience Services Ecotox GmbH / Ecotoxicology Field; J. Sorri, TRIALCAMP SLU; T. Vollmer, Eurofins Agroscience Services Ecotox GmbH / Ecotoxicology Field; S. Knaebe, EAS Ecotox GmbH / Ecotoxicology Field The publication of the proposed EFSA risk assessment for pollinators resulted in an increasing demand for experiments with non-Apis pollinators. As bumble bees (Bombus terrestris L.; Hymenoptera, Apidae) are commercially available and their biochemistry is well-known, they can be used for ecotoxicological semi-field and field trials. The current study considered the semi-field and offfield (PPP) scenarios. Where a substance or use should not pass one of the screening level risk quotients, EFSA offers the possibility for refinement. This study shows the possibility for refinement in a tier I risk assessment. This includes the refinement of exposure estimates from the screening step and also additional exposure routes, such as the exposure to flowering weeds in field margins and adjacent flowering crops. The second objective of this poster is to evaluate the impact of the proposed screening and tier I risk assessments on the pass/fail rate of currently available active substances and formulated products which is an ability of the scheme to correctly identify compounds of potential concern and consequently screen out those of low concern. The aforementioned analysis follows the principles described in the ECPA impact analysis (Miles and Alix 2013) and compared the first approach with the outcome based on laboratory data.

TU041 Does assessing of all brood cells of a hive reduce uncertainty and increase reliability of Semi-field honeybee brood studies (OECD GD 75)? H. Bargen, G. Gonisir, M. Kleinhenz, B. Szczesniak, Eurofins Agroscience Services Ecotox GmbH; S. Knaebe, EAS Ecotox GmbH / Ecotoxicology Field The OECD guidance document 75 (2007) introduced a semi-field test method to assess the effects of PPPs on honeybee brood. The assessment of bee brood development over one brood cycle is conducted by mapping cells. It starts from the egg stage and the fate of individual cells is followed until hatch. For this purpose, pictures are taken at defined stages of the development cycle and compared to the development in separate control hives. Three parameters in regards to brood development are assessed and evaluated: brood termination rate (BTR) (number of the marked cells where a termination of the bee brood development was recorded, expressed as percent). This considered to be all marked cells (an indicator of the compensation of bee brood losses) and brood index (an indicator of the bee brood development, facilitates a comparison between different treatments). Due to the high variability of BTRs within treatments and high control mortality in several studies no definite conclusions regarding effects on brood were possible (Pistorius et al., 2012). To address this variance, effort was taken by the ICPPR non-API working group to develop and compare historical data and give recommendations for future testing (Pistorius et al., 2012, Becker et al. 2014). Despite fulfilling all recommendations, high variability in brood termination and high control mortality is still evident in some of the conducted studies. For those studies data interpretation and conclusions are questionable. According to Wang and Görlich (2017) one reason for the variability of brood termination rates is that the evaluation of brood development is based on a limited, defined number of cells containing eggs. According to their opinion results might be different if all cells would have been chosen. They suggested that it would reduce the uncertainty to a minimum. In this poster the recommendation of Wang and Görlich (2017) is used to find out if uncertainty can be reduced by evaluation of all cells. The brood data used were collected according to OECD 75 during a field trial in Phacelia tanacetifolia (PPC) and field offfield (PPP) scenarios. Where a substance or use should not pass one of the screening level risk quotients, EFSA offers the possibility for refinement. This study shows that exposure of young queens in semi-field trials is challenging. Many variables influence the number of produced queens, such as the right timing for the termination of the study or the condition of the colonies at study start. Based on data collected in the past years, different strategies to reduce the variability in the production of young queens were evaluated. Also, several parameters influencing this most important endpoint were analyzed. We tried to answer some open questions concerning the colony reproduction success, such as the experimental set-up can influence queen numbers and queen weights, how high the natural variation between colonies is and how the selection of bumble bee colonies for the studies can be improved. In current, an ICPPR Non-Apis working group is developing a standardized method for semi-field studies with bumble bees. Based on the protocols of the ICPPR working group, several semi-field studies have been conducted. The central endpoint in these higher tier studies is the colony reproduction success (production of young queens), as the production of active brood is crucial for the assessment of bee brood development of a healthy bumble bee population. However, assessing the production of young queens in semi-field trials is challenging. Many variables influence the number of produced queens, such as the right timing for the termination of the study or the condition of the colonies at study start. Based on data collected in the past years, different strategies to reduce the variability in the production of young queens were evaluated. Also, several parameters influencing this most important endpoint were analyzed. We tried to answer some open questions concerning the colony reproduction success, such as the experimental set-up can influence queen numbers and queen weights, how high the natural variation between colonies is and how the selection of bumble bee colonies for the studies can be improved.

TU043 Higher-tier risk refinement of solitary bees in the field - is the well-known 'focal species' concept a suitable approach? J. Lueckmann, M. Faupl, J. Ludwigs, Rifcon GmbH According to EFSA (2013) bumble bees and solitary bees have to be considered in addition to honey bees in the risk assessments. However, suitable testing methods in the lab are currently partly available only (e.g. for acute contact & oral bumble bee testing, acute contact solitary testing) or under development (e.g. chronic oral bumble bee testing, acute oral solitary testing). Regarding appropriate species for solitary bees EFSA (2013) proposes Osmia cornuta or O. bicornis as test organisms for the risk assessment, and higher-tier semi-field testing with Osmia as proposed by the ICPPR non-API working group has been recommended. However, experiences from current field studies on Osmia show that exposure of adults and larvae is not necessarily given as these solitary bee species have a pronounced polylectic feeding behaviour that can result in a low exposure to a test substance (i.e. not being a real worst-case). In order to address this problem, the refinement of worst-case solitary bee risk assessments under realistic field conditions may be achieved by using a 'focal species' concept, where most appropriate focal solitary bee species can be identified to represent a worst-case choice per crop, application time and country/zone. Whereas this approach is well-known for bird and mammal risk assessment it has not been yet applied for...
solitary bees. Here, we present the idea of a ‘focal species’ concept for solitary bees, its needs, refinement options, advantages and limitations.

TU 044 Non-Apis (Bombus terrestris) versus honeybee (Apis mellifera) acute oral and contact toxicity - Preliminary results of ECPA company data evaluation
A. Dinter, Crop Science Division; N. Hanewald, BASF SE / Ecotoxicology; H. Krueger, EAG Laboratories; A. Zicot, SynTech Research / Ecotoxicology; E. SOLER, TRIALCAMP SLU / Ecotoxicology; S. Kimmel, Innovative Environmental Services (IES) Ltd. / Ecotoxicology

A preliminary data evaluation was conducted by ECPA companies to compare the sensitivity of bumblebees (Bombus terrestris) with the sensitivity of honeybees (Apis mellifera). For the evaluation about 70 data sets were available for contact exposure and about 50 data sets for oral exposure. The data sets comprised insecticides, fungicides, herbicides in about equal numbers plus a few other substances. The preliminary ECPA company data evaluation of LD50 values indicates lower or similar contact sensitivity of bumblebees vs. honeybees. Similarly, lower or similar oral sensitivity of bumblebees vs. honeybees was determined with one exception for an insecticide that indicated higher acute oral bumblebee sensitivity compared to honeybees. For this insecticide, higher tier data indicates no negative impact on bumblebees at the maximum intended use rate.

TU 045 Bumblebee (Bombus spp.) 10 day feeding laboratory test design: First results from an ICP-PR Non-Apis working group
N. Exelder, Bayer AG, Crop Science Division; N. Hanewald, BASF SE / Ecotoxicology; C. Jenkins, EnviGO; H. Krueger, EAG Laboratories; A. Zicot, SynTech Research / Ecotoxicology; E. SOLER, TRIALCAMP SLU / Ecotoxicology; S. Kimmel, Eurofins AgroScience Services GmbH; S. Vinall, Mambo-Tox Ltd; K. Amsel, BioChemagrum GmbH; S. Haupt, IBACON GmbH; S. Kimmel, Innovative Environmental Services (IES) Ltd / Ecotoxicology

A decline in some pollinator species has led to an increasing pressure on political decision makers and regulatory bodies and resulted in a change of existing risk assessment paradigms and testing approaches. The published and already revised EFSA GD on the risk assessment of PPP on pollinators includes apart from the honeybee also bumblebees and solitary bees. In the need to address long term effects on bumblebee health the ICP-PR Non-Apis working group designed a rang test protocol to develop a first-tier chronic feeding test for bumblebees. Based on the recently published honey bee 10 day chronic feeding test guideline OECD 245 and the bumblebee acute oral toxicity guideline OECD 247 a 10 day feeding test was set-up using dimethoate as reference substance. The response of adult Bombus spp. workers to the test chemical Dinethoate EC-400 (Perfektion) was evaluated within a 10 day chronic feeding laboratory test design. The test item was provided ad libitum for a period of 10 days. During the exposure phase bumblebees are kept individually in cages –“single housing”. Bumblebees do not share food via trophalaxis and need to be fed individually. Furthermore, single housing prevents hierarchy fights (among the queen-less BB workers) potentially introducing mortality. Mortality and behavioral abnormalities in the test groups were observed and recorded daily and compared to the untreated control groups. The endpoints calculated were: LC50 (median lethal concentration) and LDD50 (median lethal dietary dose) values after 10 days and if possible the NOEC (no observed effect concentration) and NOEDD (no observed effect dietary dose). First results indicate that with this method reproducible results were obtained. The mortality in the control groups seem not to exceed 15 % (evaluation currently ongoing) and the overall food consumption allowed for a proper evaluation of the intended endpoints.

TU 046 Standardization of method to test toxicity of stingless bees
The ICP-PR University thec Estadual Paulista Júlio de Mesquita Filho / Biology: R. Rocelli, UFS Car / Departamento de Ciências da Natureza Matemática e Educação; O. Malasina, UNESP Universidade Estadual Paulista Júlio de Mesquita Filho / Departamento de Biologia, Centro de Estudos de Insetos Sociais Brazil is the country with the greatest diversity of bees in the world. The Brazilian bee fauna consists of 5 families: Andrenidae, Apidae, Colletidae, Halictidae, and Melittidae, with 943 described species from 11 subfamilies: Xylocopinae, Nomadinae, and Apinae. The subfamily Apinae comprises 19 tribes, among them the Meliponini, commonly known as 'stingless bees'. However, several species have been included in the list of endangered animals and there are many reports indicating a decrease in the abundance of all native species. To ensure protection of this huge diversity and continued growth of agriculture, it is important for Brazil to have a system to evaluate which compounds are safe for bees and efficient in agriculture. Current toxicity studies in bees are carried out with the Apis mellifera, but stingless bees present a very different behaviour and biology. The oviposition process, the internal care of the hive, the feeding system, the nest building materials and the size of the hives are quite variable. However, there are no specific methods for toxicity tests to stingless bees. So, in our laboratory we are developing and standardizing methods to test the toxicity of pesticides to species of stingless bees. We test the Acute Contact Toxicity Test protocol of OECD guidelines (214) established to European honeybee for the stingless bees Scaptotrigona postica and Melipona scutellaris. For this, we use the recently updated EFSA guidance document “Acute Contact Toxicity Test for stingless bees some adaptations in OECD (214) are necessary, like to adjust the temperature of the incubator (29 ± 2 °C instead of 25 ± 2 °C), anesthesia should be done by cooling and the time should be adequate for each species. The development of these tests will allow the development of safer strategies for the protection of biodiversity and, at the same time, support the expansion of agriculture, which is an important socio-economic activity in the region.

TU 047 A method for a solitary bee (Osmia spp.) first tier acute oral laboratory test: an update
I. Roessink, Alterra / Environmental Risk Assessment; N. Hanewald, BASF SE / Ecotoxicology; C.W. Schneider, BASF SE; N. Exelder, Bayer AG, Crop Science Division; E. Noël, SynTech Research; A. Schnurr, BioChemagrum GmbH; A. Molitor, Eurofins AgroScience Services GmbH; E. SOLER, TRIALCAMP SLU / Ecotoxicology; S. Kimmel, Innovative Environmental Services (IES) Ltd. / Ecotoxicology; J. Van der Steen, Alveus AB Consultancy

The recently updated EFSA draft honey bee Guidance document also specifies other hymenopteran pollinators, like solitary bees and bumble bees, as groups to take into consideration when assessing the risk of plant protection products to pollinators. However no validated test protocol and consequently no extensive data set is available to compare sensitivities of other relevant pollinators to those of honey bees. Within the current project of the ICP-PR Non-Apis working group a study was made to develop a first-tier acute oral test for Osmia spp. bees. Based on the honey- and bumble bee guidelines OECD 213 and OECD 247 an acute oral test was designed using dimethoate as reference substance. Osmia bicornis and Osmia cornuta were housed individually and fed a known amount of test volume per dosage. First results indicate that with this method reproducible results were obtained. In these tests, control mortality never exceeded 12 percent. Furthermore, sensitivities of O. cornuta and O. bicornis appeared to be rather similar, although O. cornuta showed a slightly less sensitive response, (which might be) due to its larger bodyweight. Hence, the LD50 values after 96 hours ranging from 2.6 – 7.1 ug ai/bee indicate that a validated and workable methodology has been set up and a general guideline is within reach.

TU 048 2 years of Solitary Bee Semi-field Ring Testing and Final Conclusions (ICPPR Non-Apis Working Group)
S. Knaebel, EAS Ecotox GmbH / Ecotoxicology; N. Exelder, Bayer AG, Crop Science Division; L. Franke, J. Fricke, Eurofins AgroScience Services Ecotox GmbH / Ecotoxicology Field; M. Fromberger, Julius Kuehn Institut; T. Jutte, Julius Kuehn Institut; S. Kimmel, Innovative Environmental Services (IES) Ltd / Ecotoxicology; O. Klein, Eurofins AgroScience Services Ecotox GmbH / Ecotoxicology Field; J. Lueckmann, Rifcon GmbH; H. Giffard, Testapi; A. Rossbach, Tier3 Solutions GmbH / Field team; C.W. Schneider, BASF SE; A. Schnurr, BioChemagrum GmbH

The publication of the proposed EFSA risk assessment guidance document of plant protection products for pollinators highlighted that there are no study designs for non-Apis pollinators available. Since no official guidelines exist for semi-field testing at present, a protocol was proposed and two years of ringtests were conducted in 2016 and 2017 to develop a general test set-up. The ringtest design was based on the EFSA guidance document, OEP/EPPO Guideline No. 170 and results on discussions regarding testing solitary bees during the meetings of the ICPPR Non-Apis working group in 2015, 2016 and 2017 followed by a workshop in 2017 to harmonise methodology. Ringtests were conducted with two representatives of a solitary bee species (Osmia bicornis L and Osmia cornuta Latr.; Hymenoptera, Megachilidae). These species are polylectic and can forage on a diverse spectrum of flowering crops. They are nesting in cavities. Both are common species in Europe commercially available and are widely used for pollination services. Several laboratories participated in the higher-tier ring tests. 8 semi-field tests were done in 2016and 9 in 2017. Two treatment groups were always included in the ringtest: an untreated control and dimethoate as a toxic reference item (optional other i.e. brood affecting substances (fenoxycarb)). In the study design adult bees were exposed in the tunnels during their reproductive period. Adult bees, as well as their offspring, were exposed to the treated pollen and nectar during development. Relevant endpoints for this study design are observations of the flight activity in front of the nesting units, nest occupation (i.e. number of nesting females), the production of complete cells and cocoons per female, the brood...
termination rate during the larval development as well as the success of emergence of their progeny (F1-generatation) in the following year. Based on the results of the ringtests over 2 years a draft protocol is available together with recommendations for the methodology needed. This includes how the cocoon incubation and hatching of bees can be synchronised with the onset of flowering, how fit solitary bees are out of season and which substance at what rate can be used as reference item for brood studies.

**TU049**
Predicting wild bee sensitivity to Acetylcholine Esterase (AChE) inhibitors utilizing a trait based phylogenetically controlled approach

T. Pamminger, BASF SE; Agrarzentrum Limburgerhof / Ecotoxicology; N. Hegglin, BASF SE / Ecotoxicology; C.W. Schneider, BASF SE; J.C. Becker, New York State Dept. of Environmental Conservation / Biology; M. Bergtold, BASF SE

Plant protection products (PPP) play a vital role in modern agricultural practice. Nevertheless, their potential off-target effects on managed (e.g. *Apis mellifera*) as well as wild (most non-Apis species) bees have emerged as an intensively discussed topic. In current risk assessment, *A. mellifera* is used as a reference species in pollen and honey to cover potential adverse effects of PPPs on non-Apis bee species. However, as robust and scientifically sound information regarding the sensitivity of non-Apis bee species are scarce the validity of this approach has been challenged. As a first step to address this question we have compiled a comparative data set of the Acetylcholine Esterase (AChE) inhibitors sensitivities of 21 bee species, covering five families of bees. We will show how this data set was compiled using information on bee body weight, a trait likely influencing bee sensitivity to PPP exposure. Our phylogenetic controlled analysis shows that bee bodyweight is a robust predictor of bee sensitivity to AChE inhibitors and confirms that *A. mellifera* is particularly sensitive to this class of PPPs. In contrast, many stingless bee species, are comparatively resilient to AChE inhibitors, especially when controlling for body weight. We discuss the consequences of these findings in the context of the global non-Apis bee risk assessment debate in Europe and the Americas.

**TU050**
New approaches in testing of pollinator exposure under realistic conditions - Methods and recent experiences

M. Perszehi, Tier3 Solutions GmbH; U. Zumkier, Tier3 Solutions GmbH / Regulatory Science; A. Rossbach, Tier3 Solutions GmbH / Field team; C. Wolf, Tier3 Solutions GmbH

With the growing concern for insect populations and an increased awareness of the importance of pollinators in the public opinion as well as in the regulatory context related to pesticides, methods required to evaluate pure exposure to plants in pollinator foraging have been developed. The methods discussed in this paper are based on the determination of residues as part of (semi-) field studies with bees in pollen, nectar and honey. The methods used need adequately reflect the properties of the tested substance and the circumstances of the application as well as potential influences of behavioural aspects such as foraging behaviour. Also, residue kinetics of a given substance have to be considered and must be reflected in the time points used for sampling. Here, we present recently employed approaches for studies which may further enhance the methods discussed exemplified by the determination of residues in bee samples. Studies on foraging behaviour as well as methods to adequately determine residues for non-standard uses, such as home and garden uses, ornamentals and granules with a slow release formula. The different methods are compared and advantages and potential pitfalls are illustrated.

**TU052**
Normative Instruction 02/2017 - Brazilian risk assessment of pesticides to bees

F. Viana-Silva, C. Dias, L. Borges, K. Cham, C. Tonelli, R. Oliveira, A. Alves, IBAMA / DIQUA; CGASQ; R. Rebelo, IBAMA / CCONP

Globally there are increasing concerns about possible decline in pollinators which requires that efforts be made in the direction of identifying its possible causes and in establishing policies for protecting pollinators. The Brazilian Institute for the Environment and Renewable Natural Resources (ibama) is responsible for environmental assessments in the context of pesticide registration in Brazil. Since 2011 Ibama is implementing the risk assessment of pesticides in Brazil and one of the main points of this new risk assessment procedure is the determination of residues in bees. In this context, it was published in February 2017 the Normative Instruction 02 (NI 02/2017) that establishes procedures to risk assessment of pesticides to pollinators. This is the first Brazilian specific regulation based on a risk approach, and in July 2017 Ibama published a Environmental Risk Assessment of Pesticides to Bees which explains in an accessible way how the normative should be applied. NI 02/2017 is widely based on US/Canada’s approach, which means that it focuses on *Apis mellifera* data; the models used for screening are Bee-Rex and AgDrift; tests required for tier 1 are the same and there is one scheme for foliar applications and other for soil/seed/duck treatments. But there are few modifications: 4 tiers, the last one being post-registration monitoring; use of a safety factor of 10 for non-Apis bees; residue trials must be performed in Brazil and for tier 2 a crop grouping is considered. With this normative Ibama expects that pesticides be used efficiently without incurring unacceptable risks to bees. Although Ibama has a full framework for risk assessment established for honeybees there are still gaps in knowledge and research needs for ensuring that procedures to protect bees can be improved, especially regarding native bees. Hence, a matrix of selection for Brazilian bee species was proposed for selecting native species for use in pesticide risk assessment. This matrix provided the basis for electing meliponines (stingless bees) as a priority group. In the near future Ibama intends to assess the need of changes in the risk assessment procedure, eventually including a stingless bee as a representative species.

**TU053**
How the new Brazilian risk assessment framework for bees works

K.d. Coelho, ADAMA BRASIL / Regulatory Affairs; G. Weyman, ADAMAThe Environmental Assessment of pesticides in Brazil is performed by the Environmental Institute of the Ministry of Environment (IAMA) and completed within the framework of Hazard Potential Assessment and Environmental Risk Assessment. The Hazard assessment has been established since 1990 but the Risk Assessment, although required since 1996, only started to be implemented by IBAMA in 2012 and has been developing further since then. Due to numerous global discussions on the decline of pollinators, in February 2017 Ibama published the first ruling (“normative”) to establish guidelines, requirements, and procedures for a systematic risk assessment scheme of pesticides for pollinators in Brazil. Further guidance for the scheme was issued later in 2017. The Brazilian overall approach is similar to EPA, but there are nuances in the Brazilian scheme regarding which active ingredients must be tested, and additional considerations for future which must be understood. Using hypothetical data from a mixture and a single active ingredient we will show how the new Brazilian “methodology (currently)” works for two use patterns, foliar and soil application, considering the main aspects of Tiers 1 and 2 of the risk assessment. Furthermore, the main points of this Brazilian risk assessment framework for bees will be compared with those adopted by other countries, considering both similarities and differences. Keywords: Pollinators, bees, risk assessment, Brazil

**TU054**
An epidemiological study about an effect of neonicotinoids residues on honey bee colony survival in Japan

Y. Kameda, Chiba Institute of Technology / Creative Engineering; E. Fujita, K. Takada, Chiba Institute of Technology / Chemical Engineering, Agriculture and Food Science; H. Tanaka, Chiba Institute of Technology / Food Engineering

Neonicotinoid insecticides are widely used in Japan. Seven neonicotinoid insecticides such as Imidacloprid, Acetamiprid, Thiacloprid, Clothianidin, Dinotefuran, Thiamethoxam and Nitopyram are popular. Their usage began from the beginning of 1990 and is increasing till 2008 in Japan. Recent annual total usage of seven insecticides is not increasing, approximately 400 tons per year in Japan. But it is not clear how these insecticides affect bees. Therefore, an epidemiological study about an effect of neonicotinoids residues on honey bee colony survival in Japan by ELISA analytical methods. The exposure assessment is conducted by neonicotinoids residue concentrations in adult honeybees, pupae, pollen and honey. These samples were collected from beekeepers around in Japan. Information about condition of colonies was also collected from beekeepers. Wild honeycombs were also collected. The six neonicotinoids were detected in all samples including honey, pupae and adults. Especially, more than ten times higher concentrations were detected in some honey bee samples than those reported by previous reports in Europe, Canada and America. All colonies where adult honeybees were exposed by high concentrations were evaluated as abnormal condition such as CCDs, massive fatalities and sacbrood disease. Moreover, possibility of abnormality of colonies was strongly dependent on residue concentrations in adult honeybees. It was very interesting that EC50 values of colony abnormality, derived from this epidemiological research, were not much different from LC50 of adult bees. The values and the ELISA screening techniques could be one of easy warning values for beekeepers which indicate possibility of colony abnormality.

**TU055**
Thiamethoxam Honey Bee Large Scale Colony Feeding Study - Design and Interpretation

N. Ruddle, Syngenta Ltd / Product Safety; H. Thompson, Syngenta Ltd / Environmental Safety; J. Oliver, Syngenta Crop Protection UK Ltd / Environmental Safety; C. Elston, Syngenta Ltd; M.A. Fekens, Syngenta / Ecological Risk Assessment; S. Bocksch, Eurofins AgroScience Services Ecotox GmbH / Ecotox Honeybees; P. Thorbek, Syngenta / Environmental Safety; M. Hill, Eurofins AgroScience Services Inc

Colony feeding studies were originally developed to directly assess the insect growth regulating properties of insecticides and designed to determine mode of action rather than effect levels. More recently there has been regulatory interest in conducting colony feeding studies to determine the pesticide level in nectar substitute (sucrose solution) which leads to colony-level effects, thereby allowing
for comparison with residue concentrations detected in pollen and nectar from treated and untreated crops. In 2016, a honey bee colony feeding study was conducted with thiamethoxam with the aim of providing a robust colony-level endpoint for comparison with residues in pollen and nectar. Analyses of the colony data indicate there were clear significant effects at the highest concentration of 100 µg/kg for many colony parameters and overwintering survival. At 50 µg/kg, despite a few treatment differences for pollen stores, overall colony strength and overwintering survival were similar to the control, confirming the NOAEL as 50 µg/kg. The NOEL was determined to be 37.5 µg/kg. To assess the potential risk to honey bees from exposure to thiamethoxam and metabolite CGA322704 (clothianidin) residues in pollen and nectar, the NOEL and NOAEL can be compared to measured residues in treated or untreated crops. In a treated oilseed rape-exposure study (Pilling et al., 2013) the maximum thiamethoxam residues found in pollen and nectar were 1.0 µg/kg and 3.0 µg/kg, respectively. The residues of CGA322704 were below the 1.0 µg/kg LOQ. In an on-going study, residues in pollen and nectar in untreated succeeding crops of sugar beet were also found to be low. The maximum thiamethoxam residues in pollen and nectar were 2.6 and 0.55 µg/kg, respectively. A maximum CGA322704 residue of 6.3 µg/kg was detected in pollen, while residues in nectar were less than the 1.0 µg/kg LOQ. The colony NOEL and NOAEL concentrations are an order of magnitude greater than the maximum residues in succeeding crops and a treated crop. The colony NOEL and NOAEL provide the basis by which to evaluate the potential risk of thiamethoxam residues detected in pollen and nectar. It also provides additional support for the lack of effects reported in field studies following exposure of colonies to levels of thiamethoxam in pollen and nectar of seed treated crops that are an order of magnitude lower than the no effect level observed in this study.

TU056

Alteration of the alternative splicing pattern in honeybees’ nervous system genes as a tool to test pesticides toxicity

P. Dehais, UNESP Universidade Estadual Paulista Júlio de Mesquita Filho; T. Roat, UNESP Universidade Estadual Paulista Estadual Júlio de Mesquita Filho / Biology; O. Malaspina, UNESP Universidade Estadual Paulista Júlio de Mesquita Filho / Departamento De Biologia, Centro de Estudos de Insetos Sociais; M. Soller, University of Birmingham

Evidence-based knowledge on pesticide effects on pollinators, such as honeybees, has become mandatory in many countries. It is important to establish lines of action approved internationally to provide farmers and policy-makers more information about the applications of pest management programs. With this in mind, this work evaluated whether sublethal doses of the insecticide thiamethoxam, the fungicide carbendazim, and the herbicide glyphosate would be capable of altering the alternative splicing of genes in honeybees. We used RNA extracted from the brains were dissected for RNA extraction. We analyzed alternative splicing of the genes encoding to RNA encoding to the brain synapse proteins with restriction enzymes and then separated these fragments on denaturing agarose gels. We used an alternative splicing primer library for Elav and Dscam. Because the PCR products have very similar sizes but differ in sequence, we digested the PCR products with restriction enzymes and then separated these fragments on denaturing polyacrylamide gels. It was not possible to observe a differentiated pattern of splicing for Elav neither for Dscam, comparing the control groups with the bees exposed to pesticides. The doses used and the exposure time in our study was not sufficient to indicate these genes as biomarkers in Apis mellifera. However, further studies are needed, exploring different doses, contamination routes, and increasing the exposure time to verify if these pesticides are capable of altering the alternative splicing pattern of genes directly related to the nervous system. (Fapesp: 201522368-5).

TU057

Non-uniform distribution of treated sucrose solution via trophallaxis by honeybees affects variability of homing success rate, gene expression and mortality among replicates

L. Jolles, Swiss Bee Research Center / Agroscope; Y. Christen, University of Applied Sciences and Arts Northwestern Switzerland

We compared the impact of the feeding regime group dosing with 10 bees versus group dosing with two bees per cage on the variability of the homing success rate, gene expression and mortality. Based on our own observations and the recently published publication (Brodischneider, R. et al. (2019), it seems that food sharing via trophallaxis might lead to a non – uniform distribution of the tested sucrose solution between caged bees. This can cause high variability on measured parameters among group members, replicates and treatments. For honey success rate and gene expression endpoints, bees were orally exposed to different sub-lethal concentrations of thiamethoxam (TMX) at 0.1, 0.3 or 1 ng/bee, based on the homing flight ring-test protocol. For mortality, bees were exposed orally to dimethoate at 0.033, 0.07, 0.1, 0.13, and 0.35 µg/bee, based on the acute oral toxicity test guideline OECD 213. For both methods, the treatment-feeding regime, was conducted with ten bees/cage and two bees/cage. Homing flight success rate, at 1ng TMX/bee, was significantly lower with ten bees compared to the two bees approach. A large variability of success rates and gene expression among treatment replicates was found in the ten bees feeding group. Acute toxicity data with dimethoate showed that group feeding scheme with ten bees per cage resulted in higher mortality when compared to two bees (at same dosing levels). As consequence, the LD50 value is higher for the latter. High variability of homing success, gene expression or mortality rate in the ten bees feeding scheme is most likely caused by inhomogeneous dose distribution among bees, or either by over- or under dosing of single bees within replicates. A more accurate and uniform dosing distribution can be expected between 2 bees resulting in less variable data between runs, replicates and treatments. We highlight that feeding in smaller groups of honeybees should be considered and discussed to minimize the trophallaxis dependency regarding food distribution in group dosed honeybees. Moreover, to compare endpoints of toxicological studies with single dosed wild bees for regulatory purposes. <br>doi:10.1371/journal.pone.0174684

TU058

Modelling and validation of honeybee foraging behaviour for the pesticide risk assessment

M. Wang, WSC Scientific GmbH / Dept Efate Modelling; C. Dietrich, WSC Scientific GmbH

In recent years a number of population models have been developed for honeybees and many have been used for pesticide risk assessment. While the in-hive development of honeybees is relatively well understood and can be validated relatively easily in models, the accurate estimation of exposure is more complex and more difficult to validate. In particular, foraging behaviour, which is included only in very few models, plays an integral role for exposure, since it determines to what extent foragers collect nectar or pollen from treated or untreated crops and other habitats, or if they find alternative food sources. Foraging behaviour is also tightly related to weather. We therefore evaluate how foraging behaviour can be implemented and validated in a honeybee model simulating natural conditions, with particular focus on the risk assessment of pesticides and on the protection goals formulated in the recently published honeybee guidance.

TU059

Automated waggle dance decoding

M. Wang, WSC Scientific GmbH / Dept Efate Modelling; J. Kleinmann, A. Görlich, WSC Scientific GmbH

In honeybee field studies EFSA recommended in its latest guidance that field studies should ensure that the 95% exposure percentile is met. Practically, it is challenging to confirm where honeybees actually foraged. In recent years a variety of methods have been developed and tested to establish a kind of foraging maps, based on waggle dance observations analyses, harmonic radar or RFID chips. Most of these, however, can realistically be used only based on relatively few individual bees. We therefore explored options for an automated analysis of waggle dance in honeybees. The system should facilitate the use of standard hives and should be usable without a computer in the field. We evaluate the reliability of the method.

TU060

How to increase test power and understand risk in refined honeybee trials


For honeybee semi-field and field studies EFSA defined SPGs (specific protection goals) in its latest guidance document on the risk assessment of plant protection products (PPP) on bees. Detrimental effects on colony size as a result of PPPs should not exceed a 7% threshold to not endanger the fulfillment of the ecosystem service patterns provided by honeybees. The measurement of effects on colony size as small as 7% is often difficult to achieve due to high uncertainty and variability both reducing the test power. By applying a modified field methodology and test design the test power can be increased substantially thus allowing to conduct field studies that are able to reach the SPGs. For the semi-field study colonies with sister queens of equal strength were used. From these a subset of colonies was selected based on high foraging performances, which started approximately four weeks prior to exposure, by selecting those colonies that would be similar during the exposure phase. During the whole study the colony strength was assessed by photographing all bees in hives (all frames and walls). Additionally, to include also the number of foragers in the assessment, hive weights were weighted with and without bees. To avoid an influence of the time of the day on the number of foragers counted with photography all colonies were photographed at a parallel at the same time of the day. All frames of all hives were also photographed to assess brood development and to obtain a full overview of the condition of each hive at each time point. It is shown that by applying a refined, new field methodology and test design for field studies on honeybees the
test power referring to the number of adults can be increased. Assessments of complete hives, including adults and all cells, make it possible to gain a detailed insight into the development of colonies and hive parameters over the course of time. Environmental factors and their influence on different hive parameters can be assessed and used to explain how these parameters either alone or in conjunction with plant protection products have an impact on the strength and development of honeybee colonies.

TU061 The potential for immune activation and possible consequences for bees upon exposure to microbial pest control agents

B. Jones, M. Whittaker, Applied Insect Science Ltd

Microbial pesticides are unlikely to cause disease in non-target insects due to a lack of specific pathogenicity. However, simply exposing the insect to a microbe has the potential to activate subclinical responses that can lead to colony level effects. For example, injection with a non-pathogenic, microbial immune elicitor induces a massive antimicrobial peptide response in bumblebees and honey bees. This immune response lasts several days and is costly to maintain. These costs are demonstrable through trade-offs between immunity and other life-history traits such as learning and longevity. In addition, immune activation alters many aspects of normal colony functioning, such as changes in foraging activity, decreased queen attendance, modified feeding behaviour, increased production of sexuals and forced ejection. Crucially, many of these effects only become apparent in the colony, and show specificity between bumblebees and honey bees. The established paradigm uses laboratory trials as a ‘worst-case’ scenario to progressively increase to higher tier field trials, which may mask the downstream immunological impacts on endpoints such as longevity. Evidence exists for immune activation in insects via oral exposure with non-pathogenic bacteria. We therefore propose the need to establish whether oral and cuticular contact with microbial pesticides can induce the immune system in bees. Should immune activation be confirmed in the laboratory in the absence of lethal effects, further field trials may be required to reveal the consequences within the colony.

Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (P)

TU062 Assessment of Levels of Some Heavy Metals in the Organs of West African Dwarf Goat and Beef Cattle in Ogbomoso, Nigeria

A.A. Giga, Cape Peninsula University of Technology / Department of Pure and Applied Chemistry; O.A. ADESOYE, Ladoke Akintola University of Technology / Department of Pure and Applied Chemistry; F. Wewers, Cape Peninsula University of Technology / Chemistry

The dangers inherent in the exposure to heavy metals present in food products especially meat, have aroused widespread concern for food safety and human health. With increasing human activities and anthropogenic pollution sources, there has been deposition of large amounts of various toxic metals in the food material which may ultimately make their passage into the tissue. This study aims at assessing the levels of five heavy metals (lead, cadmium, zinc, copper and iron) in organs of West African dwarf goat and beef cattle slaughtered in Ogbomoso metropolis, Nigeria. Chevon and beef samples of heart, intestine, liver, muscle and tripe were collected from both sexes of two breeds of cattle and the organs were digested and analyzed using the method described by the Association of Official Analytical Chemistry. The results show that there are significant differences (p < 0.05) in the concentrations of the metals in the different parts and sexes of the animals studied. The estimation of the non-essential metals in the investigated samples indicated the following range: lead 1.11–6.00 mg/kg and Cadmium 1.25–6.52 mg/kg while that of the essential metals are Zinc 1.27–7.65 mg/kg, copper 17.00–72.30 mg/kg and iron 98.93–352.00 mg/kg. The results also revealed that the concentrations of lead, cadmium and iron exceeded the stipulated permissible limits. Higher-than-limit concentrations are observed more in the various parts of cattle organ than in both of the two cattle species. There was, however, no significant difference (p=0.05) in the amount of these metals accumulated by both sexes of the animals. There was no major reduction in the results obtained on the samples when compared with fresh samples for all the metals analysed. From the various data obtained, it can be concluded that all the five metals are present in all the samples analyzed and their average concentrations are significantly high in most of the samples. Cooking lowered the amount of the potentially toxic metals in the meat samples.

TU063 Assessment of metal bioaccessibility, bioavailability and toxicity in soil using the earthworm

P.Y. Roh大道, AGAT Laboratories, Ltd / Specialty services Division; Z. Omouri, INRS-Institut Armand-Frappier

Simultaneous contamination of ecosystems by various substances sets a challenge as regards to environmental assessment. One of the aspects is appraisal of pollutant bioavailability. Such an analysis was performed on a mixed contaminated site. The earthworm Eisenia andrei was exposed to different soils according to a contamination gradient. An integrated approach including a suite of biomarkers and chemical analyses was adopted to determine site toxicity. Parameters of the antioxidiant system (catalase [CAT] and superoxide dismutase [SOD] activity), an enzyme of detoxification metabolism (glutathione S-transferase activity [GST]) as well as acid phosphatase (AP) activity and lysosomal membrane fragility of coelomocytes (neutral red retention time, NRRT) were used as tools. Overall toxicity endpoints (lethality, body weight change, reproduction) were assessed. Lethal effects were detected in some soils whereas chronic endpoints significantly decreased. A significant response of time-growing extent and consistency was recorded for SOD from 2–28 days, whereas effects on other enzymatic markers were low and temporarily inconsistent. NRRT also was significantly decreased after 28 days but was significantly increased compared to the negative control. Metal bioavailability was assessed and used to explain how these parameters either alone or in conjunction with plant protection products have an impact on the strength and development of honeybee colonies.

TU064 Assessment of subcellular metal-binding ligands in white suckers (Catostomus commersonii): are all the metals accumulated in the heat-stable fraction (HSP) detoxified by binding to metallothioneins?

N. Urein, INRS-ETE / Centre Eau Terre Environnement; S. Jacob, P-G. Campbell, P. Couture, Université du Québec, INRS / Centre Eau Terre Environnement

The dangers inherent in the exposure to heavy metals present in food products especially meat, have aroused widespread concern for food safety and human health. With increasing human activities and anthropogenic pollution sources, there has been deposition of large amounts of various toxic metals in the food material which may ultimately make their passage into the tissue. This study aims at assessing the levels of five heavy metals (lead, cadmium, zinc, copper and iron) in organs of West African dwarf goat and beef cattle slaughtered in Ogbomoso metropolis, Nigeria. Chevon and beef samples of heart, intestine, liver, muscle and tripe were collected from both sexes of two breeds of cattle and the organs were digested and analyzed using the method described by the Association of Official Analytical Chemistry. The results show that there are significant differences (p < 0.05) in the concentrations of the metals in the different parts and sexes of the animals studied. The estimation of the non-essential metals in the investigated samples indicated the following range: lead 1.11–6.00 mg/kg and Cadmium 1.25–6.52 mg/kg while that of the essential metals are Zinc 1.27–7.65 mg/kg, copper 17.00–72.30 mg/kg and iron 98.93–352.00 mg/kg. The results also revealed that the concentrations of lead, cadmium and iron exceeded the stipulated permissible limits. Higher-than-limit concentrations are observed more in the various parts of cattle organ than in both of the two cattle species. There was, however, no significant difference (p=0.05) in the amount of these metals accumulated by both sexes of the animals. There was no major reduction in the results obtained on the samples when compared with fresh samples for all the metals analysed. From the various data obtained, it can be concluded that all the five metals are present in all the samples analyzed and their average concentrations are significantly high in most of the samples. Cooking lowered the amount of the potentially toxic metals in the meat samples.

TU065 Assessment of Toxicological Impact of Anthropogenic activities on Onitsha Stretch of River Niger in Southeastern Nigeria

A.C. Udebuani, Federal University of Technology / Department of Biotechnology; J.J. Nwajuba, Federal University of Technology Owerri / Department of Biotechnology; p. Abara, federal university of Technology Owerri / Biology

The impact of anthropogenic activities on an urban stretch of a major river in Nigeria with respect to endocrine disrupting compounds and heavy metal concentrations was investigated. Three sampling points were selected along the Onitsha stretch of River Niger, based on the inlets of different tributaries into the river. Heavy metal contents of the water samples were analyzed after acid digestion, while the endocrine disrupting compounds were analyzed using gas liquid
chromatography. The result obtained showed that six heavy metals with varying concentrations were obtained in the order of Zn>Pb>Hg>Cd>Ni. The HPI and MI values were far above the critical values. Results also showed EDCs obtained to include PAH, phthalates, PCDs, PDCFs, PBDEs, bisphenol A and PCBs. This study established that Onitsuka stretch of River Niger contains varying concentrations of heavy metals and EDCs. The stretch of that river is highly polluted, and anthropogenic activities are highly impacting negatively on the river. Therefore, there need to regulate the activities of people, especially the influx and disposal of pollutants into this surface water.

TU066 Comparing metallic elements in corals from South Africa and the Mascarene Basin
V. van der Schreff, North-West University / Unit for Environmental Sciences and Management; R. Choong Kwet Yive, University of Mauritius / Chemistry; H. Bouwman, North-West University / Unit for Environmental Science and Management
Coral reefs are one of the most bio-diverse biomes on earth. One of the many dangers that coral reefs face is the accumulation of metals and metalloids in their tissues and skeletons of the colonies. No knowledge exists on the state of metal and metalloid contamination in corals from the Western Indian Ocean (WHOI). Fragments of four soft- and five hard coral genera were collected from five sites in the WHOI. Sodwana and Aliwal Shoal constituted the coastal sampling localities from South Africa. Three Mauritian outer-islands in the Mascarene basin (Agalega, Rodrigues, and St Brandon’s Atoll) were the selected oceanic sampling sites. Eighty-one coral fragments were collected and analysed for 31 metallic elements using ICP-MS. The corals collected from South Africa contained a higher concentration of most of the metals that were analysed compared with the Mascarene Island samples. Corals without symbiotic algae could only be collected from the South African reefs, and contained the highest concentration of metalloids. Soft corals exhibited a different relative composition pattern of metals than hard corals. We been earth to analyse safe treatments on different organisms of the hard corals. Soft corals contained relatively higher concentrations of most of the post-transitional metals that were analysed. *Sinularia* is the coral genus with the most elements at the highest concentrations. *Pocillopora* from SBR had very high concentrations of Fe and Cr, possibly due to several shallow shipwrecks in the atoll. Most of the elements tested had lower concentrations in the WHOI than in certain regions of the Great Barrier Reef and the Red Sea. Iron was consistently higher in all corals collected during this study than in corals from other studies. Some metals, such as Cu, Ni, and Cd, affect fertilization success of corals. Very high concentration of Ni was reported in *Sinularia* (1300 mg/kg dm) from Sodwana. As ocean temperature rises and ocean acidification increases, metals can become more bioavailable to corals, requiring further study.

TU067 Cytochrome P450, fat and ageing: new insights into metal toxicity
N. Rai, Oerebro University / The Life Science Centre School of Science and Technology; P. Olsson, Oerebro University / The Life Science Centre-Biology; L. Jag, Oerebro University / The Life Science Centre-Science and Technology
Toxic metals are among the most persistent environmental pollutants worldwide and have been implicated in metabolic disorders, including diabetes, obesity and neurological diseases. Long-term exposure to metals increase the susceptibility of healthy individual to hematological and developmental disorders. Several genetic markers including metallothioneins, heat shock proteins and oxidative stress related genes have been used to analyse metal effects on different organisms. Other biomarkers for metals include cytochrome P450 (CYPs) a class of xenobiotic metabolizing enzymes that can transform compounds to either non-toxic or carcinogenic metabolites. Studies have shown that CYPs can metabolize important fatty acids and regulate lipid metabolism. Both CYPs and fatty acid metabolism have been implicated the ageing process and lifespan regulation, however the mechanisms has not been clearly determined. Current research allows a promising new model to study stress response mechanisms induced by metals due to some functional similarities with humans. Our aim was to study the mechanism behind the metal induced CYPs and fatty acid metabolism alterations leading to regulation of lifespan in *C. elegans*. Transcriptomics, viability, lifespan, gene expression analysis and RNA interference were used to explore the interconnection between the CYPs, fatty acid metabolism and lifespan in *C. elegans* following metal exposure. *C. elegans* were exposed to metal contaminated environmental samples and lab reconstituted 12 metal mixture during post hatching larval stages (L1 to young adult). Transcriptomic analyses showed upregulation of *cyp-33A1*, *cyp-35B1* and *cyp-35B2* genes on exposure to both the metal mixture and environmental sample exposure. Further, fatty acid metabolism related genes such as *fasm-1, pod-2, acs-2* and *fat-5* were also altered on exposure to both the metal mixture and environmental sample. Our results show that metals alter the CYPs and fatty acid metabolism and can have functional implications on the lifespan of *C. elegans*. Understanding the interplay of CYPs and fatty acid metabolism can unravel possible mechanisms of metal induced onset of several diseases and their detrimental effect on the longevity of exposed individuals.

TU070 Determination of the effects of platinum in the oyster (Crassostrea gigas) using cell and tissue level biomarkers
R. MEDRANO, University of the Basque Country; M. Abdou, UMR5805 EPOC / Geochemistry; M. Soto, University of the Basque Country / Zoology and Animal
Aquatic organisms, nonetheless the reported medium guidelines. The last one is based on the results obtained in toxicology tests using purposed, metals entering aquatic ecosystems are regulated by water quality continuity of living organisms. In this context, metals is a group of pollutants in aquatic ecosystems is a global problem affecting the biological nature medium on metal toxicity and new approach for effective metal toxicity preventing interference of culture medium. In this study, we studied the effects of culture medium on metal toxicity. Based on these results, our second purpose was to propose a new approach for the evaluation of metal toxicity on microalgae avoiding the interference of culture medium. In this study, we evaluated the toxicity of copper (Cu), lead (Pb) and zinc (Zn) on the microalgae Pseudokirchneriella subcapitata, since they are considered to be more sensitive to chemicals compared with other aquatic organisms such as fish. Cu and Zn were chosen for our study metal speciation play an important role in the activity. However, for the other study metal, Pb, any positive, biological function has not been reported. All tests were run in transparent microplates (96 wells), and pH of test solutions was adjusted at 6.5. The algae growth was determined measuring the fluorescence (435/685 nm). In the first experiment, the microalgae was exposed for 72 hours to each metal using three different types of culture medium, OECD modified OECD (mOECD) and Bold Basal Medium (BBM). In the second experiment, the microalgae was exposed in a simplified test medium (destilled water buffered with MOPS and NaOH) only for 6 hours, as nutrients available for algae were limited. In the first experiment condition, the EC50 after 72hours were 140, $\times 1200$ and 293 $\mu g/L$ for Cu, Pb and Zn in OECD medium, respectively, in mOECD, they were 34, 219 and 134 $\mu g/L$, respectively and in BBM, they were >300 $\mu g/L$ in all the cases. In the second experiment, the obtained EC50 after 6h were 150, 189 and 88 $\mu g/L$ for Cu, Pb and Zn, respectively. The obtained EC50 of the metals differed between culture mediums. So the composition of culture medium affect the metal toxicity. Hence, we suggest that the simplified test medium may be an appropriate alternative to evaluate metal toxicity preventing interference of culture medium.

**TU07**

**Environmental diagnosis of water and tilapia Oreochromis niloticus of the Tenango dam, Puebla, Mexico.**

M. Manoz-Najera, G. Barrera Escrigue, Universidad Autónoma Metropolitana; Iztapanalapa / Hidrobiologia; P. Ramirez Romero, U.A.M. Iztapanalapa / Hidrobiologia Human population has seen the deterioration of resources derived from their overexploitation and contamination by anthropogenic activities, an example of this is water. Due to the growing demand for this resource, associated to human population growth, industry, livestock, and agriculture, dams have been built to satisfy these needs. In Mexico, some of them were constructed in sites where over time were declared protected natural areas. Population settle on its banks to make use of the water, as well as the organisms linked to these aquatic bodies, which represents economic sustenance for the inhabitants. On the other hand, it is common to use the water for various purposes, many of which contradict each other. Such is the case of the Tenango Dam, in Puebla, México, which is used for fishing, irrigation, and electric power generation, among other purposes. This study was aimed to evaluate the aquatic and ecological quality. Field samples were collected in 2015. Physicochemical parameters were recorded: pH, dissolved oxygen and temperature; as well as nutrients: nitrates, nitrites, phosphorus; and metals: cadmium, chromium, copper and lead. Results indicated that the physicochemical parameters are within Mexican admissible ranges. Nitrite and nitrogen phosphorus exceed the acceptable limit for urban use and protection for aquatic life. Lead and chromium in water exceed the limits in four collections, and tilapia, only in two of them. Cadmium and copper registered in water behaved similarly exceeding in two seasons the levels allowed by Mexican law, while in tilapia, cadmium only exceeded the acceptable limits for consumption in two seasons. Based on the concentrations of nutrients and metals, it is concluded that water and the Tenango dam is not suitable for urban use, nor for the protection of aquatic life, and tilapia should not be consumed. These levels of contaminants could represent a risk to the life associated with this artificial water body. The diverse uses and the absence of a management strategy have deteriorated the dam’s water quality and also the tilapia as a resource associated with it; finally, this situation compromises the integrity of an aquatic body included in a site declared as protected natural area.  

**TU074**

**Estimation of Target Hazard Quotients and Potential Health Risks of Some Heavy Metals from Lipsticks in Nigeria.**

O. Akogbusi, Federal University of Agriculture, Department of Biochemistry; A.C. Udegbaun, Federal University of Technology / Department of Biotechnology; T. Oritoju, University of Nigeria Nsukka / human nutrition and dietetics

Heavy metals have been implicated as a causal factor in literally any health problem including infertility and cancer. Their presence in most cosmetic products may pose more harm than envisaged. Lipsticks are common beautifying cosmetics used by young women. This study was aimed to evaluate the hazard quotients of heavy metals from lipsticks and potential health risks. The presence of heavy metals in most lipsticks may help to predict the possible risk associated with the use of these products. The main objective of this paper is to evaluate the hazard quotients of heavy metals due to direct ingestion or use of lipsticks among users and also to evaluate target cancer risks due to its use. This study was carried out in Wukari, Nigeria, samples of different lipsticks and lip glosses of many colours and texture were collected and analyzed for heavy metals contents (lead, Arsenic, Chromium, Cadmium and Mercury) using Atomic Absorption Spectrophotometer (AAS). The result of the mean concentration of the heavy metals are as follows; Lead, ranges between(2.65-7.40 ± 0.17) mg/kg;
Arsenic concentration range between (0.55-1.53 ± 0.26) mg/kg and chromium was 0.04-0.16 ±0.02) mg/kg. Cadmium and arsenic concentrations were below detectable limit of 0.001 mg/kg while mercury concentration ranges between 0.04-0.61 ± 0.01) mg/kg. Calculated target hazard quotient (THQ) was highest in mercury with the value of 0.56.29 and the lowest value was obtained in Arsenic with 1.43×10^5. However, target cancer risk (TR) was highest for Lead with the value of 2.3×10^-3 to 2.1×10^-10. This shows that some lipsticks products popularly used in Nigeria contain high concentration of heavy metals such as Lead, Arsenic, Chromium, Cadmium and Mercury and they have high cancer risk. Therefore, public health awareness on the risk associated with the use of these cosmetic samples should be carried out.

TU075 Fatty acid profile of Cerastoderma edule and Scrobicularia plana affected by copper sulphate exposure
A.D. Mesquita, Department of Biology & CESAM - University of Aveiro / Department of Biology and CESAM, F. Gonçalves, University of Aveiro / Department of Biology and CESAM; J.C. Marques, University of Coimbra / Dep. of Life Sciences, Coimbra University; A.M. Gonçalves, MARE, Dep. of Life Sciences, Coimbra University/Biology Department & CESAM, Aveiro University
At the past 30 years were recorded an intensive practice in the use of fertilizers and pesticides, mainly in the European Mediterranean region, that, in particular cases, exceeded the limits of regular legislations established by the European Union. The wide usage of these chemicals has increased the pollution of horticultural and agricultural fields near valuable ecologically coastal areas conducted to the implementation of monitoring plans to the recovering of aquatic ecosystems. Copper sulphate is used in industrial activities, but also it is much used in pesticides formulations, with application in agricultural activities, namely in rice farms to control pests. Studies reported that copper may affect biochemical processes, such lipid metabolism of some organisms, and when exposed to high concentrations may引起 change the health of the organism, that is still unknown. Nowadays, bivalve species are used in ecotoxicological bioassays due some particular characteristics, such as the wide distribution, ecological relevance, the capacity to filter and ingest large volumes of sediment particles and water and ease handling in the field and in the laboratory. Therefore, this work aims to determine toxic effects and changes in fatty acids profile composition of the two marine bivalve species Cerastoderma edule and Scrobicularia plana when exposed to copper sulphate, considering small (medium body size = 1.97 cm and 3.47 cm, respectively) and big (medium body size = 2.45 cm and 4.20 cm, respectively) size classes. In a first phase experiments were performed under laboratory conditions to copper sulphate to determine lethal concentration; at a second phase, it was considered the field exposure to bivalve species and their nutritional status and size classes at the field and in the lab. Our results state C. edule is more sensitive to copper sulphate (LC50 = 0.818 (0.595 - 0.987) mg/L; 1.129 (0.968 - 1.289) mg/L, to big and small organisms, respectively) than S. plana (LC50 = 2.563 (2.229 - 2.903) mg/L; 4.705 (3.540 - 12.292) mg/L, to big and small organisms, respectively). Furthermore the last one presents greater abundance and variety of FA and essential fatty acids (EFA), namely DHA and EPA, rates than C. edule. Still, big size class of both bivalve species is the most affected by the contaminant.

TU076 Metals removal from water for hazard classification
G. Bizon, University of Michigan / School for Environment and Sustainability; M. Hudson, University of Michigan / School of Natural Resources and Environment; R.F. Carbonaro, Mutch Associates, LLC / Civil and Environmental Engr; K.J. Rader, Mutch Associates, LLC; S. Baken, European Copper Institute; E.R. Garman, NiPERA / Ecotoxicologist
Metals usually enter aquatic ecosystems in anoxic environment and associated with particulate matter. It is important to evaluate the toxicological impact of these heavy metals as their presence in the water column can affect the health of aquatic life, including humans. The objective of this study was to develop a method to evaluate the toxicological impacts of metals in aquatic environments, using OECD method 29. What sediment characteristics affect metal removal and which show a reasonable worst case condition (RWC) condition? What is the mechanism for metal removal, and are metals released into overlying waters upon subsequent resuspension? Method parameters evaluated included: sediment type and loading rate, pH control, metal loading rate, pre-incubation of sediment, and resuspension. Sediment loading rates included dissolved Cu, Ni, and Fe, oxygen (DO), pH and AVS-SEM of sediments. Multiple dried vs. non-dried sediments were tested in batch reactors for both 96 h and 28 days. Dry Buffalo River sediment, a sediment with reasonable worst-case properties for metal binding, typically removed 70% Cu and Ni from the water column at 1 mg/L loading. Incubated sediments removed metals significantly faster than non-incubated sediments (p < 0.03). Higher sediment loading rates of metals faster as expected. Sediment type and loading rates affected pH, which started at 6.0. Cu removal (96 h) and resuspension (1 h post 96 h) resulted in no significant increase in Cu, but did elevate Fe concentrations. The results show that 70% of Ni and Cu is removed from the water.
column using this test modified OECD 29 test method, using a variety of sediments and conditions.

TU079
Modelling the chronic toxicity of copper to fish at low pH
S. Baken, European Copper Institute; K. De Schampheleire, Ghent University (UGent); Applied Ecology and Environmental Biology
Bioavailability models account for the effects of water chemistry on metal toxicity to biota. They are a cornerstone of the environmental risk assessment of many trace metals, including copper. In this context, it has often been assumed that toxicity of dissolved copper to fish increases with decreasing pH. However, some studies show that this relationship may only be valid above pH 7. Below pH 7, the chronic toxicity of dissolved copper to fish seems to be independent of pH. Existing bioavailability models use the well-known mechanistic concept of the Biotic Ligand Model (BLM), but this modelling framework seems to have difficulties to reproduce the observed relationship of copper toxicity versus pH. This study was set up to refine the bioavailability models for chronic copper toxicity to fish, in order to better reflect the observed relationship between chronic copper toxicity and pH. The available chronic copper toxicity data to fish were reviewed. A new bioavailability model was developed using the concept of a generalized bioavailability model (gBAM). This semi-empirical model assumes a log-linear relationship between pH and effect concentrations (ECx) expressed as free cupric ion activity (Cu2+) and links it to the geochemical speciation model WHAM7 to predict toxicity on a dissolved copper basis. The existing bioavailability models were used and compared to the newly developed gBAM. The underlying assumptions, advantages and limitations of each model are identified. Conclusions and implications for modelling copper bioavailability to fish are discussed.

TU080
Novel In-situ Toxicity Assessment of Sediment Capping Effectiveness in Deep Water Shallow Lakes
G. Burton, University of Michigan / School for Environment and Sustainability; M. Hudson, University of Michigan / School of Natural Resources and Environment; S. Niedrich, A. Rentschler, University of Michigan; K. Thiamkeelakul, University of Michigan School for Environment and Sustainability; S. B. Brown, The Dow Chemical Company / Environmental Remediation and Restoration
A former mining site has been the subject of intensive restoration for the past few years, with significant focus on disconnecting mine spoils from groundwater and managing the quantity and quality of runoff. A remaining task is to ensure that concentrations of zinc in surface water of a large pit lake are reduced below water quality standards. An investigation was conducted to compare the efficacy of different methods for reducing zinc pollution concentrations in surface water from a mining site in Michigan. Laboratory tests, controlled release from biodegradable, highly porous polymer sponges (15 to 19°C, depending on deployment period). Results from in-situ testing demonstrated the usefulness of the TACS and provided similar correlation was demonstrated between variation in te...
through thiobarbituric acid reactive substances (TBARS) measurement in the muscle tissue. The results showed changes in the behaviour and enzymatic activity at the different copper sulphate concentrations to both size classes. Moreover, according to TBARS levels, lipid peroxidation possibly occurred on the big size class of *C. edule*. The muscle tissue (foot) showed to be a good tissue to use in biochemical analysis to detect response to the exposure to toxicants.

**TU084**

The impact of single metals and mixtures in nature: a microcosm experiment

M. Van Ginneken, University of Antwerp, Dept. Biology / Biology (SPHERE); R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)

Even though ecotoxicological risks of metal-contaminated systems remains an important challenge. While laboratory experiments with metal mixture exposure are receiving more attention in the literature, little research has examined the interaction of natural stressors with metal mixtures. In the lab, we already performed experiments on *Axelius aquaticus*, exposing this freshwater isopod to a combination of metal mixtures and temperature stress. This way we could study effects on the individual level and relate metal accumulation to relevant sublethal endpoints (e.g., growth rate, feeding rate). The present study, a microcosm experiment in a greenhouse, was designed to gain more insight into the effects of these metals on populations and communities. Small ecosystems with several species of macroinvertebrates were exposed to Cd, Cu, Pb and a mixture of these three metals under semi-natural conditions. In each bucket, we placed *Axelius aquaticus*, *Daphnia magna*, *Cryptocerus japonicus* with different *Physio*, *Eisenia fetida* (macrophyles) and *Raphidocelis subcapitata* (algae). The theoretical metal concentrations were 1.5 µg/L Cd, 70 µg/L Cu, and 72 µg/L Pb. Half of the medium was renewed weekly. The effects of the metal mixtures and natural stressors were examined after 4 and 8 weeks, on the individual level (total metal accumulation, survival, shoot and root length), the population level (species densities, biomass) and the community structure (diversity, evenness). Preliminary results show high variability between replicates. We observed no significant differences in species densities between the metal treatments after 4 or 8 weeks. After 4 weeks, we found that Cu and the tertiary mixture negatively affected shoot and root length of *E. nuttallii* compared to the control treatment. However, after 8 weeks, we did not find these significant differences. As we could not find any significant effects of the metals at the end of the experiment, further research focused on sublethal factors or with a longer exposure duration is needed.

**TU085**

The influence of soil properties on lead bioavailability and toxicity to *Enchytraeus crypticus*

L. Zhang, VU University Amsterdam / Animal Ecology; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science

Soil properties are important factors modifying metal bioavailability to soil organisms and subsequently affecting the metal toxicity. The present study aimed at investigating the bioavailability and toxicity of lead to the potworm *Enchytraeus crypticus* from soils with different properties. Soils with a wide range of properties were spiked with Pb(NO₃)₂ at 9 concentrations of Pb to determine the effects of soil properties on Pb bioavailability and toxicity to *E. crypticus*. Survival and reproduction after 21 d exposure were related to total, 0.01 M CaCl₂ extractable and porewater Pb concentrations in the soil and internal Pb concentrations in the surviving animals. Pb₄Ca₃S₂ and Pb₄S₃ decreased with increasing total Pb concentration in the soil solution, but pH decrease was much stronger for the soils with lower CEC and OC contents. Sorption of Pb from the CaCl₂ extracts could be well described by a Freundlich isotherm (R² = 0.96-0.99) and Freundlich sorption constant Kₛ increased linearly with increasing cation exchange capacity (CEC) (R² = 0.86) or organic carbon content (OC) (R² = 0.76). Pb bioaccumulation in the *Enchytraeus* was soil-dependent, but differences between soils almost disappeared when relating Pb bioaccumulation to available Pb concentration in soils. Toxicity values varied greatly among soils, with median lethal concentrations (LC₅₀) based on total Pb concentrations ranging from 246 to >3092 mg Pb/kg dry soil. LC₅₀ on the basis of total Pb concentration increased linearly with increasing CEC (R² = 0.70-0.90) or pH₄Ca₃S₂ (R² = 0.87-0.94). The differences in Pb toxicity among soils could be related to the available Pb concentrations in soil (R² = 0.97) and internal Pb concentrations (R² = 0.97). Median effective concentrations (EC₅₀) based on total Pb concentrations varied 12-fold among soils from 81 to 1008 mg Pb/kg dry soil. EC₅₀ on the basis of total Pb concentrations increased linearly with increasing pH₄Ca₃S₂ (R² = 0.70-0.94). The variation in EC₅₀ was best explained by differences in the CaCl₂ extractable Pb concentrations in the soils (R² = 0.94). In general, pH was an important soil property affecting LC₅₀, EC₅₀ and internal Pb concentrations in *Enchytraeus*, as Pb availability, internal Pb, mortality and reproduction were inversely related to soil pH. Soil properties should be taken into account during the ecological risk assessment of metals in contaminated soils.

**TU086**

Toxicity evaluation of soils sampled in the vicinity of an Aluminum smelter in Montenegro using the Ames, Bioluminescence and DR-LUC bioassays

A. Perovic, University of Montenegro, Faculty of Natural-sciences and Mathematics / Biology; S. Perovic, J. Vukic, University of Montenegro Faculty of Naturalsciences and Mathematics; D. Sukovic, Center for Ecotoxicological Investigations; H.A. Leslie, Institute for Environmental Studies VU Amsterdam

This study conducted as a part of the national project ECOTOX that main topic was testing applicability of several bioassays in assessment of cause-effect relation between levels of organic environmental pollutants in soils and its toxic and mutagenic response on samples organic extracts. Samples was collected in vicinity of Aluminum Plant Podgorica and pools of red sludge in Zeta plain. This area with intensive industrial activity is also reach with agriculture and is just in 5km distance from Podgorica (Capital of Montenegro). Waters of several rivers in this area, which are significantly influenced by municipal wastewaters of tree cities, are abundantly used for watering crops in area. We tested mutagenic potential of samples organic extracts in the Ames test, on bacterial strain *Salmonella typhimurium* TA98, acute toxicity on bioluminescent bacteria *Vibrio fischeri* and concentrations of possible dioxins present in the samples by DR-Luc test on rat H4IE hepatoma cell line. The obtained results indicate a strong mutagenic effect of organic pollutants mixture in tree samples collected near the Aluminum Plant and pools of red sludge, what was significantly in correlation with the recorded concentrations of dioxins in the DR-Luc test and with measured concentrations of polycyclic aromatic hydrocarbons, which exist in the maximum allowable prescribed concentrations. Two of tree samples, with high response, were in agricultural area. Even if it is a clear trend of decrease of mutagenic effects as well as reduction of the concentration of dioxins and PAHs with increasing distance of sampling sites from the Aluminum Plant and pools of red sludge, almost all samples showed a certain elevated level of mutagenic activity, which may be a consequence of the impact of multiple sources.

**Safe by Design: responsible and innovative research for safe and sustainable chemistry (P)**

**TU087**

In silico approaches to screen and design safer chemicals

E. Papa, A. Sangion, P. Gramatica, University of Insubria / Department of Theoretical and Applied Sciences (DiSTa)

The prohibitive economic and social cost of testing, necessary to provide extensive information on fate and effects of existing chemicals to humans and the environment, highlights the need to focus on rational and safe design of chemicals before synthesis (i.e. Safe by Design – SbD approach). This approach applies the principle of green chemistry “Design safer chemicals and products,” and is useful to prevent hazardous substances from being developed and entering the environment, as well as to build safer alternatives to existing hazardous chemicals. While in the last decades computational chemistry and *in silico* models have been widely and successfully applied in the design of drugs with desirable pharmacological activity, these strategies have not yet been applied extensively in the design of sustainable, “safe by design” industrial chemicals as well as no real guidelines exist at the regulatory level. Modelling approaches based on Quantitative Structure-Activity Relationships (QSARs) rely on the assumption that biological activities/properties of chemicals are intrinsically dependent on the molecular structure. Endpoints like for instance toxicities, physico-chemical properties as well as biotic and abiotic degradations can be predicted starting from models based on molecular descriptors of the chemical structure, which serve as basis to develop the SbD approach. Therefore, in *silico* strategies such as the aforementioned QSAR (and QSAR-like) models and multivariate analysis (MVA) can be successfully applied to screen untested properties of large sets of chemicals in order to identify potentially hazardous compounds or safer alternatives. In this poster we show different examples of QSAR models mainly implemented in the software QSARINS and available in the freely distributed QSRINS-Chem module to screen “safe” from “unsafe” compounds on the basis of different endpoints of scientific and regulatory interest. Different classes of emerging pollutants were investigated using *in silico* models, such as Flame Retardants (FR), Personal Care Products and Pharmaceuticals (PPCPs) and nanoparticles. All the presented strategies support the identification of safer alternatives to chemicals that are screened by QSAR as undesirable from their molecular structure. The QSR approach, applied for SbD before the chemical synthesis, provides concrete opportunities to increase the sustainable use of chemicals and to reduce the need for *a posteriori* remedial actions.

**TU088**

Application of chemometric methods and QSAR models to support pesticide risk assessment starting form ecotoxicological datalogs

E. Galimberti, ICPS International Centre for Pesticides and Health Risk Research; Public Health Agency; A. Moretto, Università degli Studi di Milano; E. Papa, University of Insubria / Department of Theoretical and Applied Sciences (DiSTa)

Recently the International Center for Pesticides and Health Risk Prevention (ICPS) of Milan-IT, together with the Wageningen University and Research Centre of Wageningen-NL, worked on a data collection project commissioned by the Environmental Safety Authority (FEAS). The aim of the project was to investigate the comparability of the EC, approach (Effect Concentration affecting a percentage x of test organisms) to the current NOEC approach (No Observed Effect
Concentration), both derived from chronic and long-term studies of a data sets of 70 active substances of plant protection products (PPP). The new Regulation for the authorization of PPPs requires that ecotoxicological endpoint values, derived from chronic or long-term studies submitted by the Applicant, are reported as EC_{10} or EC_{20} as well as NOEC. NOEC endpoints have been recently criticized since their values strongly depends on the experimental study design, whereas EC values are considered more appropriate since they take into account concentration-response curve. Ecotoxicological data gathered from 70 active substances' approval dossiers were collected and stored into a database, and then analyzed to derive NOEC. Adequate statistical models were selected and used to calculate EC_{10}, EC_{20}, and EC_{40} with confidence intervals. In the present work, quantitative methods and models based on Structure-Activity Relationships (i.e. QSARs) were used to validate the Effect Concentrations of the active substances of the selected pesticides, and to predict missing data. The whole approach is mainly oriented to the aquatic environment, and can provide useful information to screen the potential undesired toxic effects of new pesticides, and of alternatives to existing active substances, starting just from the chemical structure.

TU089 Influence of coatings in the bioaccumulation of TiO2 and CeO2 nanoparticles in rainbow trout

M. Fernandez-Cruz, INIA - National Institute for Agricultural and Food Research and Technology / Environment; I. Rucandio, Ciemat; A. Garnica-Soto, INIA National Institute for Agricultural and Food Research and Technology; A. Viera, University of los Andes / Department of Earth Science and Technology; I. Rucandio, CIEMAT; A. Garnica-Soto, Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria / Environment; J. Trujillo, RIVM / GZB; W. Peijnenburg, RIVM / GZB; J. A. Meesters, RIVM / VSP; W. Peijnenburg, RIVM / Center for Safety of Substances and Products; R.J. van de Briel, RIVM / GZB; A. J. Sips, RIVM / VSP

In the framework of FP7 Project GUIDEnano we investigated the effect of different metal nanoparticle (NP) coatings (synthesized from PlasmaChem GmbH, Germany) on the the toxicity and bioaccumulation of these NPs trying to establish some relationships between coatings and the related effects. Bioaccumulation studies with rainbow trout have been performed for CeO2 NPs and TiO2 NPs of 4-8 nm uncoupled and coated with citrate or polyethylene glycol phosphoric acid ester (PEG). OECD Test Guideline (TG 305 diet administration) has been followed. Fish (5±1 g weight) were fed for 10 days with a diet spiked with 100 mg/kg of the NPs dispersed in water. A control group fed with pellets containing the vehicle (water) was tested in parallel. This uptake phase was followed by a depuration phase of 42 days. Whole fish, stomach and intestine were collected at different time points (0, 10, 11, 17, 24, 38 and 52 days). In addition at the end of the uptake and depuration phase liver and gills were also collected. The levels of the metals in these tissues were measured by inductively coupled plasma mass spectrometry after an acid digestion. During the treatment and depuration phase, no signs of toxicity and no differences in fish growth or in the hematopoietic index among groups were recorded. At the end of the uptake phase levels of Ti could be measured in stomach, gills and liver without differences among TiO2 NPs. A difference was observed for the uncoupled NP for which Ti levels in the fish were higher than for the for the coated NPs. Ti levels reached basal values already in the first day of depuration indicating a very fast elimination of these NPs from the organism. Higher levels of Ce with respect to the control group could be measured at the end of the uptake phase in stomach, intestine and gills but not in liver. Ce levels were found in fish treated with the coated NPs but not in the groups treated with the uncoupled NPs. Levels of Ce could be measured the first day of depuration in stomach and intestine of fish treated with CeO2 NPs coated with citrate whereas Ce was only detected in the stomach of fish treated with CeO2 NPs uncoupled or coated with PEG. After 7 days of depuration, Ce residues reached basal levels indicating a lack of accumulation of these CeO2 NPs. These results indicate a different behavior for the CeO2 NPs and TiO2 NPs. No relationship could be observed between the coating and the observed effects.

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TU090 Colloidal characterization of nano-enabled products for the restoration of works of art: environmental fate of nano-innovations

E. Coisson, University of Venice - Department of Environmental Sciences Informatics and Statistics; V. Cazzagon, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; E. Semenzin, Ca Foscari University of Venice / Department of Environmental Sciences Informatics and Statistics; A. Bonetto, University CaFoscari Venice / Environmental Sciences, Informatics and Statistics; A. Brunelli, University Ca Foscari of Venice; E. Dei, University CaFoscari Venice / Department of Environmental Sciences Informatics and Statistics; A. Volpi Ghirardini, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; C. Giuliani, G. Di Carlo, CNR ISMN; M. Salzano De Luna, M. Lavorgna, CNR IPCB; A. Marcomini, University of Venice / Department of Environmental Sciences Informatics and Statistics

The development of highly innovative techniques and technologies for artworks preservation is providing conservators with new engineered nanomaterials (ENM) and ENM-based formulations that can enhance performance and technical sustainability of art materials [1]. However, the human health and environmental impacts that may potentially emerge from these new materials and/or technologies are still little known and requires an adequate assessment and management of potential risks [2,3]. ENM formulations are increasingly preferred for conservation interventions compared to the corresponding bulk materials formulations because of their small size and enormous specific surface area that favour their interaction with the material to be conserved/restored. But the small size, coupled with their capacity to adsorb biomolecules, allow these NPs to be rapidly transported to reach sub-cellular locations leading to potentially higher localized concentrations and toxicity. A lot of factors such as size, shape, surface coating and the fact that these particles are subject to fast alteration, make complicate the elucidation of the interaction mechanisms of these nanomaterials with the artefact material and the surrounding environment including the nano-bio interaction. In this context, in the frame of the EU 2020 NANOBIO project, innovative nano-enable formulations for the conservation and restoration of modern and contemporary artworks have been provided, following a Safe-by-Design (SbD) approach. The safety of the new formulations was investigated by applying both EU CLP self-classification approach for mixtures (ECHA, 2017) and experimental in vivo and in vitro ecotoxicological tests. In order to better understand the key interactions occurring between ENMs and the biological medium during the tests, the colloidal characterization of the new formulations was performed by means of Dynamic Light Scattering (DLS) and Centrifugal Separation Analysis (CSA) techniques. Moreover, possible releases from outdoor conserved works of art were also investigated by immersion tests, simulating the exposure of the treated materials to the worst applicable environmental conditions (e.g. rain, humidity, temperature).

TU091 Considerations for Safe Innovation: The Case of Graphene

M. V. Park, RIVM / GZB; J. T. Quik, RIVM / DMG; E.A. Bleeker, W. Brand, RIVM / GZB; T. de Jong, RIVM / GZB; W. Peijnenburg, RIVM / DMG; W. H. de Jong, RIVM / GZB; J.A. Meesters, RIVM / VSP; W. Peijnenburg, RIVM / Center for Safety of Substances and Products; R.J. van de Briel, RIVM / GZB; A. J. Sips, RIVM / VSP

Safe-by-design in chemistry may positively contribute to a circular economy by avoiding the introduction of hazardous substances. Specifically in nanotechnology the terms “Safe innovation” and “Safe(r)-by-design” are popular, referring to the goal of considering safety aspects already at an early stage in the innovation process of (nano)materials and nanoenabled products. We specifically look at the case of Graphene and investigate the possibilities of considering safety aspects during various stages of the innovation process. Based on this we suggest that in the first stages a clear description of the production processes and substances involved is needed in order to assess the potential for exposure. After this the standardization of the production process becomes important in order to reach a more reliable exposure assessment and enable use of exposure reduction measures where needed. Furthermore we outline what information on graphene is already available for assessing potential human and environmental hazard, exposure, and risks. For example a first indication of the hazard of an (intended) product can be obtained by collecting information on a limited number of physicochemical properties of the intended graphene product: dimensions, shape and surface properties. In addition, we recommend further steps to be taken by various stakeholders to promote the safe production and safe use of graphene. We emphasize that a safe and time-efficient innovation process is only possible under the conditions of clear and timely communication between innovators, scientists, risk assessors and regulators.

TU092 Safer-by-Design framework for supporting Small and Medium Enterprises early in sustainable innovation for nanomedicine

M. Schmutz, C. Sonn, EMPA Technology & Society Lab

One of the hot topics in nanomedicine is the use of nanobiomaterials for drug delivery. On the one hand, nanobiomaterials have various expected advantages compared to its bulk material: 1) decreased doses, 2) possibility to cross biological barriers, 3) increased drug efficacy, 4) reduction of side effects, and 5) targeted drug delivery. On the other hand, the nanosize brings new challenges for risk assessment. Nanomedicine is a complex, and combines knowledge from different fields. It is at the junction among pharma, medtech, biotech, nanotech and chemical companies which are important economic and social player in Europe. In this context, the GoNanoBioMat project aims to facilitate SMEs in Europe in the decision making for developing and producing safer and sustainable polymeric nanobiomaterials for drug delivery. To do so, the consortium designed a Framework for Supporting Small and Medium Enterprises early in stage of innovation. The framework comprises sustainable material design considering the whole life cycle of polymeric nanobiomaterials, environmental and human health risk assessment. Difficulties in the nanomedicine field arise at different levels which are at the research, regulatory and manufacturing levels. Nanomedicine is still considered as a young field and needs further research to better understand the interactions of nanoparticles at the bio-interface and to find out which are the critical quality attributes (link between physico-chemical properties and toxicity, product safety, quality and purity). Furthermore, there are difficulties in reproducing environmental and human health experiments for assessing the related impacts.
the terms of handling and transportation safety. The composition of LOHC (log D 3.6) Additionally, hydrophobicity of H
esterase), cell lines (IPC
evaluation during process design. In general, the selected ESMs define simple environmental and toxicity indicators that have lower data requirements and are faster to implement than full assessment methods. However, the results they provide have intrinsically a higher level of uncertainty. Besides, the ESMs existing in the literature do not meet important criteria for utility. They are often not clear in the definitions of the environmental and toxicity indicators not transparent in background data sources and not up-to-date. Important limitations of the selected ESMs are 1) narrow life cycle scope (excluding the environmental impacts of material and biomass feedstock production) and 2) omission of some environmental aspects relevant to bio-based materials and technologies in general. Within this study, we pinpoint limitations and positive aspects of several early-stage sustainability methods. Based on this exercise we identify and propose successful elements of existing methods to be included in a framework that supports the assessment of safety and sustainability in early development phase.

L. Shen, University of Utrecht / Copernicus Institute; E. Heugens, RIVM / Centre for Safety of Substances and Products; L. Posthuma, RIVM / Centre for Safety of Substances and Products; M. C. Zipf, RIVM / Centre for Environment and Health; A. Morao, Corbion; R. Heger, Institute for Environmental Research RWTH Aachen University; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Du, Institute for Environmental Research, RWTH Aachen / Department of Ecosystem Analysis. This development and production of biofuels, and thus also the risk of a release in the environment, is rising. This implies an increased risk for a release into the environment. Aquatic systems are particularly considered to be vulnerable to fuel contaminations. (Eco)toxicological bioassays can be applied as screening tools during the early developmental phase of biofuels for obtaining information on potential hazardous properties. These bioanalytical tools can assess adverse effects of many substances on various organisms and endpoints and thus provide a rapid and reliable screening of potential biofuels for identification of potentially harmful biofuel candidates at a very early stage of product development. This testing strategy is part of a framework proposed by the new discipline of “Green Toxicology” which strives to move safety considerations of newly developed chemicals to the earliest possible moment of its lifecycle Aquatic toxicity is considered as one important ecological endpoint relevant for biofuels. Therefore, the investigation of aquatic toxicity of promising biofuel candidates focused on acute immobilisation of Daphnia magna and acute embryotoxicity and teratogenicity of Danio rerio. Moreover, genotoxicity of the biofuel candidates was also investigated in the Micronucleus assay with V-79 cells to assess the potential effects on human health. This study focuses on the investigation of two biofuel derived fuel candidates 2-Butanone and 1-Octanol. Both substances are considered very promising alternative fuels. The toxicity testing revealed a very low acute and developmental toxicity for 2-Butanone compared to 1-Octanol. 2-Butanone induced acute toxicity and genotoxicity in concentrations >2 g/L and even teratogenic effects were found at 822 mg/L. 1-Octanone did induce effects in concentrations between 7-15 mg/L. The overall results indicate that 2-Butanone is not harmful for aquatic organisms and should be focused in the further biofuel development. For a further integration of this screening approach in the biofuel development, more biofuel candidates can be investigated and, thus, more detailed information on their potential toxicity can support the development and production of green biofuels. This work was performed as part of the Research Cluster “Towards fuels from biomass” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

M. Markiewicz, Technical University of Dresden / Sustainable Chemistry Group; Y. Zhang, Dresden University of Technology / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry; S. Stolle, University of Bremen / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry. Renewable energy stored in LOHC systems could replace fossil fuels yet their environmental impacts are largely unknown. This technology is still relatively new, and requires R&D efforts to optimise its performance to commercially attractive levels. This opens the possibility to proactively design the carriers for increased operational and environmental safety. A preliminary, comparative hazard assessment was performed using automotive diesel oil as a reference. The biodegradability and acute/subchronic (eco)toxicity using: enzymes (acylcholine esterase), cell lines (ICP-81), bacteria (Vibrio fischeri), algae (Raphidocelis subcapitata), freshwater plants (Lemna minor) and invertebrates (Daphnia magna) were investigated. Test set included LOHC systems based on quinidine, ethyl-, propyl-, butyl- and phenyl alkylcarbazole. Within this study, we pinpoint limitations and positive aspects of several early-stage sustainability methods. Based on this exercise we identify and propose successful elements of existing methods to be included in a framework that supports the assessment of safety and sustainability in early development phase.

M. C. Zipf, RIVM / Centre for Environment and Health; A. Morao, Corbion; R. Heger, Institute for Environmental Research RWTH Aachen University; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Du, Institute for Environmental Research, RWTH Aachen / Department of Ecosystem Analysis. This development and production of biofuels, and thus also the risk of a release in the environment, is rising. This implies an increased risk for a release into the environment. Aquatic systems are particularly considered to be vulnerable to fuel contaminations. (Eco)toxicological bioassays can be applied as screening tools during the early developmental phase of biofuels for obtaining information on potential hazardous properties. These bioanalytical tools can assess adverse effects of many substances on various organisms and endpoints and thus provide a rapid and reliable screening of potential biofuels for identification of potentially harmful biofuel candidates at a very early stage of product development. This testing strategy is part of a framework proposed by the new discipline of “Green Toxicology” which strives to move safety considerations of newly developed chemicals to the earliest possible moment of its lifecycle Aquatic toxicity is considered as one important ecological endpoint relevant for biofuels. Therefore, the investigation of aquatic toxicity of promising biofuel candidates focused on acute immobilisation of Daphnia magna and acute embryotoxicity and teratogenicity of Danio rerio. Moreover, genotoxicity of the biofuel candidates was also investigated in the Micronucleus assay with V-79 cells to assess the potential effects on human health. This study focuses on the investigation of two biofuel derived fuel candidates 2-Butanone and 1-Octanol. Both substances are considered very promising alternative fuels. The toxicity testing revealed a very low acute and developmental toxicity for 2-Butanone compared to 1-Octanol. 2-Butanone induced acute toxicity and genotoxicity in concentrations >2 g/L and even teratogenic effects were found at 822 mg/L. 1-Octanone did induce effects in concentrations between 7-15 mg/L. The overall results indicate that 2-Butanone is not harmful for aquatic organisms and should be focused in the further biofuel development. For a further integration of this screening approach in the biofuel development, more biofuel candidates can be investigated and, thus, more detailed information on their potential toxicity can support the development and production of green biofuels. This work was performed as part of the Research Cluster “Towards fuels from biomass” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

Many sustainability assessment methods are developed for this purpose. The aim of this study is to evaluate a selection of 12 early-stage methods (ESMs), their applicability, the relevance for bio-based chemicals and the coherence of their outcomes, using bio-based lactic acid as a retrospective case study. The selected methods contain at least one of the following themes: energy, climate change, eutrophication, land use, human toxicity and ecotoxicity. These six themes were considered as most relevant for the case of bio-based lactic acid. The selected early-stage methods point to the right hotspots concerning energy and climate change, which is promising for application during process design. In general, the selected ESMs define simple environmental and toxicity indicators that have lower data requirements and are faster to implement than full assessment methods. However, the results they provide have intrinsically a higher level of uncertainty. Besides, the ESMs existing in the literature do not meet important criteria for utility. They are often not clear in the definitions of the environmental and toxicity indicators not transparent in background data sources and not up-to-date. Important limitations of the selected ESMs are 1) narrow life cycle scope (excluding the environmental impacts of material and biomass feedstock production) and 2) omission of some environmental aspects relevant to bio-based materials and technologies in general. Within this study, we pinpoint limitations and positive aspects of several early-stage sustainability methods. Based on this exercise we identify and propose successful elements of existing methods to be included in a framework that supports the assessment of safety and sustainability in early development phase.

M. C. Zipf, RIVM / Centre for Environment and Health; A. Morao, Corbion; R. Heger, Institute for Environmental Research RWTH Aachen University; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Du, Institute for Environmental Research, RWTH Aachen / Department of Ecosystem Analysis. This development and production of biofuels, and thus also the risk of a release in the environment, is rising. This implies an increased risk for a release into the environment. Aquatic systems are particularly considered to be vulnerable to fuel contaminations. (Eco)toxicological bioassays can be applied as screening tools during the early developmental phase of biofuels for obtaining information on potential hazardous properties. These bioanalytical tools can assess adverse effects of many substances on various organisms and endpoints and thus provide a rapid and reliable screening of potential biofuels for identification of potentially harmful biofuel candidates at a very early stage of product development. This testing strategy is part of a framework proposed by the new discipline of “Green Toxicology” which strives to move safety considerations of newly developed chemicals to the earliest possible moment of its lifecycle Aquatic toxicity is considered as one important ecological endpoint relevant for biofuels. Therefore, the investigation of aquatic toxicity of promising biofuel candidates focused on acute immobilisation of Daphnia magna and acute embryotoxicity and teratogenicity of Danio rerio. Moreover, genotoxicity of the biofuel candidates was also investigated in the Micronucleus assay with V-79 cells to assess the potential effects on human health. This study focuses on the investigation of two biofuel derived fuel candidates 2-Butanone and 1-Octanol. Both substances are considered very promising alternative fuels. The toxicity testing revealed a very low acute and developmental toxicity for 2-Butanone compared to 1-Octanol. 2-Butanone induced acute toxicity and genotoxicity in concentrations >2 g/L and even teratogenic effects were found at 822 mg/L. 1-Octanone did induce effects in concentrations between 7-15 mg/L. The overall results indicate that 2-Butanone is not harmful for aquatic organisms and should be focused in the further biofuel development. For a further integration of this screening approach in the biofuel development, more biofuel candidates can be investigated and, thus, more detailed information on their potential toxicity can support the development and production of green biofuels. This work was performed as part of the Research Cluster “Towards fuels from biomass” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

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New frontiers in Life Cycle Inventory data collection and modelling (P)

TI097 Predicting environmentally beneficial production pathways for chemicals with neural networks
J. Klusnitskaja, RWTH Aachen University, Institute of Technical Thermodynamics / Institute of Technical Thermodynamics; M.R. Tillmanns, A. Stemberg, RWTH Aachen University / Institute of Technical Thermodynamics; A. Bardow, RWTH Aachen University
Life Cycle Assessment (LCA) has gained wide acceptance as methodology to evaluate the environmental impact of chemical processes. However, LCA requires detailed data on mass and energy balances. Data is usually limited for processes in stages of early development. For these cases, predictive LCA approaches are required. Current predictive LCA approaches employ solely molecular descriptors to estimate the environmental impacts of products. Thus, the choice between different production pathways towards the same molecule cannot be resolved. Therefore, we propose a neural network-based approach that uses both molecular and process descriptors. The resulting neural network is able to distinguish between various production pathways for the same product while still employing only data available at early stages of development such as stoichiometry. We estimate 5 impact categories including, e.g., cumulative energy demand (CED) or climate change (CC). The novel approach is compared to a neural network trained with molecular descriptors only. The results show that integrating process descriptors increases the coefficient of determination from 0.37 to 0.65 and from 0.39 to 0.65 for CED and CC, respectively. The route-specific prediction is illustrated for methanol production from CO2 versus natural gas. It is shown that neural network models can serve as an initial screening tool for identifying environmentally beneficial new production pathways.

TI098 A Study on the development of Food LCI DB and PCR for estimating environmental footprint in South Korea
S. Cho, SMaRT-ECO / Sustainable Business Div.; S. An, S. Seol, I. Kim, SMaRT Eco Corporation
As a result of the Paris Climate Convention adopted in December 2015, 2015 countries in the world were required to implement greenhouse gas reduction, and Korea also proposed a 37% reduction target compared to BAU. In accordance with the environmental regulation of developed trends of countries, Korea is also not free from environmental regulations at the time of preparation for active response. Under the Single Market of the EU, product environmental regulations starting from automobiles in 2000 expanded to include food in 2020, requiring the disclosure of high-quality environmental information on foods. As a result, the development of a high-quality environmental information database is accelerated, and the EU has created an ILCD Data Network to induce DB registrations in each country. However, Korea’s agricultural and livestock LCA DB does not meet the ISO requirements, it is time to revise. The purpose of this study is to develop the LCA database for the estimation of the environmental footprint (PEF) on major domestic food exports to Europe and to use the common protocol and food-specific guidelines (PCR) to estimate environmental footprint, and aims to obtain EPD certification of food. To this, we benchmarked the protocol and PCR for the Korean conditions by examining the cases of the calculation guidelines of the developed countries. In the future, it is meaningful to construct a database that can be used as basic data for obtaining PEF certification for foods exported to Europe and overseas.

TI099 Transition from ILCD To Environmental Footprint: changes in the database structure, format, nomenclature, methods and other adaptations.
S. Fazio, EC-JRC; O. Dacou, RJC European Commission; R. Pant, European Commission / Institute for Environment and Sustainability; S. Sala, European Commission - Joint Research Centre / Bioeconomy unit
In 2013 a Communication from the Commission to the European Parliament (COM(2013)0196) established the Environmental Footprint (EF) scheme. The common methodology to communicate the life cycle environmental performances for EF have been defined in a specific EU recommendation (2013/179/EU). Within this framework, the International reference Life Cycle Data system (ILCD) format, developed since 2007, along with a simplified set of compliance rules called “ILCD Entry Level Requirements” has been recommended as a baseline for data development in the EF scheme. However, in the development of a database for the estimation of the environmental footprint (PEF) in a chemical plant, plant managers need to have a good understanding of the reference database. Around 55,000 characterisation factors are different (this is mainly due to the introduction of new methods, and regionalization of some of them) - 37 duplicated flows have been eliminated – 275 wrongly categorized flows have been assigned to the proper category - 218 wrong, duplicated or useless flow properties have been deleted and mapped to the remaining ones - 35 unit groups have been deleted, one new has been created.

TU101 Improving the consistency and the accuracy of water inventories of chemical sites in PlasticsEurope LCI’s in the perspective of the applicability of the wastewater assessment method Aware of processes
M. Baur, thinkstep / LCA; G. Castelan, PlasticsEurope / LCA
The ISO 14046 standard has clarified the definitions of water use and of water consumption which is the part of water withdrawn from a drainage basin not returned back to the same drainage basin. These only definitions have enabled PlasticsEurope to fix a number of important inconsistencies in its eco-profile documents, where use and consumption were sometimes used interchangeably. This has been an important step towards this short term action, in perspective of enabling the application of the latest consensus wastewater assessment method AWARE to the water consumption, PlasticsEurope and thinkstep have collaborated to improve the consistency of the data collection phase of water flows for the various projects of the program. For the purpose of good water management in a chemical plant, plant managers need to have a good knowledge of all the water flows inputs, their origin (lake, river, public supply underground...), their treatment, in what equipment or process they are employed like for example in a cooling towers or being injected in the chemical process like in steam cracking. They must know the post use-treatment and where all the outputs
end (back to the river, evaporated, in the public sewage network, in the product…). For the purpose of consistency of the Life Cycle inventory phase, it is then very important to report these collected operational flows in the ILCD input and output flows the right and same way whoever the LCA practitioner is. This will be the basis for the calculation of the consumptive water output (output minus input within the same drainage basin) and the application of AWARE. The presentation elaborates on the various operational flows of water in a chemical plant and the link to the life cycle inventory perspective and ILCD flow names. This was achieved with the help of PlasticsEurope methodology for calculating eco-profiles. It is expandable or adaptable to all kind of industrial sites. A similar work would need to be conducted on all datasets so that the consistency of water inventory gets improved in both foreground and background data, enabling a better comparability of water footprint in order to get LCA. The presentation aims to attack LCA water experts and scientists as well as people applying the water methods in practice to exchange on challenges, relevancy of aspects and to align on a continuous improvement of water data, regionalization efforts and method improvement in the future, to inspire broad application.

TU102
Methodological improvements by dynamic approaches for the life cycle assessments of buildings
K. NEGISHI, CSTB; L. Barna, INSA Toulouse / LISP; Y. Pigné, Université des Hautes T. Navarrete-Gutierrez, LIST; N. SCHOPOU, A. Lebert, CSTB; T. Gibson, Luxembourg Institute of Science and Technology (LIST)/ Environmental Research and Innovation Center of Belgium; Luxembourg Institute of Science and Technology (LIST)/ Environmental Research and Innovation Center of Belgium
Nowadays in France, environmental and energy rules for the construction sector are based on environmental performances of products assessed through LCA methodology. However, the actual practice of LCA is lacking of temporal dimension whereas the life evolution during the long lifetime span of buildings has not negligible impact on our current LCA results. A new framework of LCA method was recently proposed by L.Barna et al (2016) and A.Shimako et al (2017) with a particular attention to the process and supply chains dynamics (web tool DyPLCA, http://dyplca.pigne.org/), aiming at calculating time dependent environmental interventions and the related impacts of toxicity and climate change. The aim of this study is to investigate the environmental performance over a large time span of two low-energy single houses, one on concrete and one on timber. The time dimension was integrated on both LCA steps (LCI and LCIA) using the framework cited above. The implementation of dynamic LCA took several steps. Buildings life cycles were first modeled in SimaPro 8.02 with ecoinvent 2.2 to calculate the conventional LCI. The calculated technological and environmental interventions matrix was then used with DyPLCA web tool for temporal LCI calculation. The temporal characterization of the product system considered two parts. Temporal characteristics of the foreground system were related to the building construction, materials replacement and renovation activities during the building’s life time of 100 years. The temporal characteristics of background processes were previously integrated in a dedicated database and used with DyPLCA tool. The temporal LCI, e.g. emissions associated, is expandable or adaptable to all kind of industrial sites. A similar work would need to be conducted on all datasets so that the consistency of water inventory gets improved in both foreground and background data, enabling a better comparability of water footprint in order to get LCA. The presentation aims to attack LCA water experts and scientists as well as people applying the water methods in practice to exchange on challenges, relevancy of aspects and to align on a continuous improvement of water data, regionalization efforts and method improvement in the future, to inspire broad application.

TU103
Carbon footprint from Brazilian soybeans based on spatially-explicit life cycle inventories, including land use change
N. Escobar, University of Bonn / Institute for Food and Resource Economics ILR; J. Godar, Stockholm Environmental Institute
That location matters when it comes to quantifying environmental impacts of agricultural commodities should take responsibility on the following life cycle stages: land use change (LUC), soybean farming, domestic transport, export, and crushing, dealing with allocation challenges. In this way, our approach represents the convergence between top-down Multi-Regional IO analysis and bottom-up Attributional LCA. Preliminary results highlight the relative contributions that add up to the entire supply chain, mainly LUC, for which considering sub-national scales is crucial in the quantification of climate change impacts. Outcomes support the argument that importing countries of soybean-based commodities should take responsibility on deforestation and associated carbon emissions, provided that spatial explicit data is available. This transparency tool is meant to provide science-based evidence to the ongoing debate on global responsibility, while assisting supply chain management and governance decisions.

TU104
Carbon Footprint Projections for Japan Using Computable General Equilibrium
Y. Ichisugi, Tokyo City University; T. Masui, National Institute for Environmental Studies; N. Isubo, Tokyo City University
In 2015, Science Based Targets (SBT) has been paid attention to the world. The targets adopted by companies reducing greenhouse gas (GHG) emissions to keep global temperature below 2 degrees increase from that of preindustrial revolution. Approximately 300 companies in the world declared to follow their targets. The target to the mitigation would be based on the calculated results of Integrated Assessment Models (IAM) such as Pacific-Asia Integrated Model (AIM), Integrated Model to Assess the Global Environmental (IMAGE). However, these results usually don’t consider the entire supply chain, because of the differences of the aims of application. In contrast, Life Cycle Assessment (LCA) considers the entire life cycle chain. On the other hand, the data used in conventional LCA calculation and normally don’t include the dynamism of system. Therefore, this study aimed at the development of a dynamic evaluation of environmental impact method based on life cycle thinking to use both advantages of IAM and LCA. Currently, we try to develop the database using AIM developed by the National Institute for Environmental Studies (NIES). That model uses Computable General Equilibrium (CGE) which can estimate economic efficiency in the future, based on price mechanism in the market. In this study, we collect fundamental data using LCA database and estimate GHG emissions in the future considering the supply chain among industrial sectors. We estimated GHG emissions in 2005 as a tentative result in Japan. The total emission is approximately 1.13E+08t eq. We confirmed the validity compared with the existing report published by the ministry of the environment in Japan. In the future, we will estimate environmental impact projection considering the scenario like Shared Socioeconomic Pathways (SSP).

TU105
Network LCA as a tool to enhance data collection and usage in a value chain network
K. Moilanen, VTT Technical Research Centre of Finland; M. Myllysilta, S. Majaniemi, VTT Technical Research Centre of Finland Ltd
Keywords: LCA, data collection, value chain Life cycle assessment as defined by the ISO (14040) consists of four phases. First, the goal and scope are defined, after that the inventory analysis is performed followed by the life cycle impact assessment. At the end, the results are interpreted. The inventory analysis includes the data collection. Therefore, it is crucial to collect and handle the data correctly. Firstly, it is seen as the most time consuming phase of every Life Cycle assessment study. This is because the data are collected from various sources and the sources might be from different organization than the commissioner of the study. Secondly, the data provider might hold their data confidential. This is because the recipes might be secret, i.e. the raw materials and the amounts of raw materials and/or the amount of energy consumed in the production process reveals the cost structure of the product. Thirdly, the data provider typically gets no benefit from delivering data and putting a lot of effort to collect and get together the data. This may decrease the motivation to deliver data. The fourth aspect is the unwillingness of data providers to reveal their performance indicators to competitors, if considered that their environmental performance is bigger than those of the competitors. The idea of network LCA is to tackle all the above mentioned four challenges. The main impact of network-LCA is to produce from the confidential source data of a company network level results, e.g. carbon footprint, which may be delivered to all network members openly. At the same time, all the network members can perform a local LCA computation to study their own local footprints. In other words, network members can independently run test and understand the impact of changes relative to the current system. The idea of network LCA is to study their own local footprints. In other words, network members can independently run test and understand the impact of changes relative to the current system.
Developing guidelines for elementary flow nomenclature
A. Edelen, ORISE; W. Ingwersen, US EPA

In general, a flow in life cycle inventory data refers to an input or output to a process. Flows may be of two broad types: elementary flows or intermediate (known as "technosphere") flows according to ISO 14044 (ISO 14044 2006). Elementary flows may be defined as flows of energy, or space that are used directly from the environment or released directly back to the environment. Life cycle assessment (LCA) data providers are currently not using a common list or system of elementary flows. An early activity within the UNEP-SETAC Life Cycle Initiative was the creation of a recommended list of flow exchanges by the Data Availability and Data Quality Workgroup (de Beaufort-Langeveld et al. 2003). Elementary flows in all life cycle inventory and life cycle impact assessment sources used in a model must correspond, or match, in order to build a functional LCA model. Edelen et. al. 2017 formulated recommendations on formatting and management based on a critical review of elementary flows from eleven LCA sources. These recommendations have been used to categorize flow information into three components and flow metadata into six components. These structured components of flows allows for systematic analysis and structuring of flow components through a knowledge organizational structure (KOS). The ISO 14048 standard was used to structure the different flow and metadata components as exclusive, inclusive or user-defined nomenclatures. The KOS is maintained in a user friendly, publicly accessible interface through the US EPA terminology services. This research presentation will focus on describing the benefits of the KOS approach and the tools used to build up of pollutant urban surfaces were modelled in a model and compared for each climate over a one year period. Stormwater LCI results were calculated for different urban surfaces. Stormwater LCI results were compared for each primary source. During storm events the wash-off and transport of available pollutants via runoff were calculated for different urban surfaces (e.g. brake wear, metal roof corrosion) or (ii) an atmospheric emissions from relevant urban sources within the life cycle assessment (LCA) framework. This study determines and compares tissue specific bioaccumulation, doses delivered and induced biological damage in two species of mussels, the freshwater species Dreissena polymorpha (DP) and marine Mytilus galloprovincialis (MG), following exposures to an important radionuclide, phosphorus-32 (32P).

2. Materials and methods
The study involved 10 day exposures of mussels to 32P of varying dose rates (i.e. 0.10, 1.0 and 10.0 mGy/d) taking into account a current no-effect screening value of 0.24 mGy/d (European Commission). The first set of studies determined 32P accumulation in specific mussel tissues (i.e. adductor muscle, digestive gland, mantle, gills and ‘other’), internal mussel water (water inside the mantle cavity), shell and faecal matter using scintillation techniques. From this bioaccumulation study, we were able to highlight key tissues of interest; the digestive gland for example, received the greatest proportion of 32P independent of mussel species. In the next set of studies, a suite of biological responses of mussels were investigated in digestive gland and gill cells. This included the induction of DNA damage (Comet assay) and repair response (Gammar-HAX2), the induction of micronuclei (MN) and the expression of key stress related genes (i.e. SOD, CAT, GST, HSP70/90).

3. Results and discussion
Our findings highlighted DNA damage and MN induction at radiation doses as low as 0.1 mGy/d in digestive gland (MN = also in gill) in both species, below the screening benchmark. Furthermore, compared to fresh water (DP), marine bivalve (MG) displayed a greater induction of DNA damage (both tissues) across all 32P treatments. This study highlights that (a) radionuclide activity concentrations in a biological system cannot be predicted by surrounding environmental media (b) with regards to bioaccumulation of waterborne contaminants, whole body measurements may mask the tissue specific nature of radionuclide uptake, and (c) the importance of adopting a multi species, multi biomarker approach when assessing the possible effect of contaminants in the aquatic environment.

TU109 Endocrine disruption in Mytilus galloprovincialis: Is ethinylestradiol a vitellogenin inducer?
L. Fernández González, P. Sanchez Marín, University of Vigo / Ecology and Animal Biology; G. Grueiro Noche, S. Muniategui Lorenzo, University of A Coruña / Analytical Chemistry Department; A. P Diz, University of Vigo / Biochemistry Genetics and Immunology; r. beiras, University of Vigo / Toralla marine sciences station (ecimar). Vittellogenins (Vtg), the egg-yolk precursor in female oviparous animals, is a common biomarker of estrogenicity widely used as an indicator of endocrine disruption in aquatic environments. Nevertheless, in the case of mollusks, it is still unclear if the synthesis of Vtg is regulated by steroid hormones as in the case of vertebrates. In the case of the synthetic hormone ethinylestradiol (EE2) the results of the studies are inconclusive. The aim of this work is to verify whether the synthetic hormone ethinylestradiol (EE2) induces the production of Vtg in Mytilus galloprovincialis at two exposure times and different nutritional regimes. For that, we used a shotgun label-free proteomics approach by high resolution LC-MS/MS to identify and quantify Vtg in mussels gonads. In this way, we can verify if the energetic balance is a key confusing factor in Vtg production. The relationship between the maturity state of mussels and their Vtg levels was studied as another possible confusing factor. Mussels from uncontaminated area in Galicia (Spain) were collected in autumn/winter, corresponding with early gametogenesis stage (known as “technosphere”). Mussels were exposed during 4 and 24 days to 100 ng L$^{-1}$ of EE2 to assess whether Vtg synthesis was induced by EE2. During exposure, mussels were fed three times per week with two different regimes: a low regime (equivalent to 0.29 % of mussel dry weight per day) or with a high regime (equivalent to 5.55 % of mussel dry weight per day), representing negative and positive energy balance respectively. For the low feeding regime, shotgun proteomics identified an detected Vtg only in female gonads. The results showed an increase in Vtg levels in mussels exposed for 4 days to 100 ng L$^{-1}$ of EE2 to assess whether Vtg synthesis was induced by EE2. During exposure, mussels were fed three times per week with two different regimes: a low regime (equivalent to 0.29 % of mussel dry weight per day) or with a high regime (equivalent to 5.55 % of mussel dry weight per day), representing negative and positive energy balance respectively. For the low feeding regime, shotgun proteomics identified an detected Vtg only in female gonads. The results showed an increase in Vtg levels in mussels exposed for 4 days to 100 ng L$^{-1}$ of EE2 to assess whether Vtg synthesis was induced by EE2. 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Integrating natural processes in environmental hazard assessments of the oil sands

D. Nunes Cardoso, CESAM, University of Aveiro / department of Biology & CESAM; J. Pestana, CESAM & University of Aveiro / Biology; S. Goncalves, Department of Biology & CESAM - University of Aveiro / Department of Biology and CESAM; A.M. Soares, University of Aveiro / department of Biology & CESAM; F.J. Wrona, University of Calgary / Department of Biological Sciences; S. Loureiro, Universidade de Aveiro / Biology

The Athabasca oil sands deposits in northern Alberta, Canada are a naturally occurring mixture of bitumen, sand, clay and other minerals. Bitumen, which is a heavy and extremely viscous oil, is mined and then subsequently refined to produce gasoline, diesel and other hydrocarbon-based products. Moreover, the naturally occurring Athabasca Oil sands deposits are a source of both physical and chemical stressors to regional rivers that flow through the deposit. Physical stress on aquatic biota from natural bitumen results from hillslope erosion processes and slumping of material into the rivers, while chemical stress arises from bitumen-derived contaminants entering the waters. To fully understand the ecological and cumulative effects of oil sands mining activities on aquatic ecosystem water quality and associated biological structure and function, there is a need to evaluate the effects of naturally occurring bitumen in the aquatic environment. The main objective of this study was to evaluate the possible ecotoxicological effects associated with the slumping of river bank material (i.e. oil sands deposit that naturally enters the river systems through fluvial geomorphological processes). A series of inter-related laboratory ecotoxicological assays were conducted before and after the slumping of oil sands to the river. A series of techniques was used to measure the overall DNA methylation level as starvation and exposed to different temperatures (8, 12 and 16°C) under different exposure scenarios. However, metabolomics is an emerging field and to interpret the use of metabolite data for the understanding of toxicological responses is challenging. We need to know what is “normal”. The variability in individual metabolomes for a species, or a “background metabolome” should be established to determine possible contributing factors such as stress and moulting (during changes in life stages) that may influence data interpretation. Thus, we have characterised the effect of these factors on the metabolic variability in the freshwater invertebrate, *G. pulex*. Herein, an analytical method is presented for the extraction and non-target analysis of the metabolome in *G. pulex*. Briefly, a dual phase liquid extraction was used followed by HILIC-HRMS to enable detection and annotation of metabolic features extracted from individual animals. Animals collected from the field were analysed immediately and compared to animals that were extracted after a fixed period of acclimatisation to laboratory conditions. The results indicated that sex, moulting stage and acclimatisation period affected the metabolic variability and factors that are likely to influence metabolomic analyses should be investigated to aid understanding of pathways involved in effect-based studies. Furthermore, it may be possible to select and screen animals to create a defined metabolome that may be used to identify adverse effects that may be associated with environmental contaminants. References. 1) Zhang, T., et al. (2012). *Analytical chemistry*, 84(4), 1994-2001. Keywords: metabolomics; invertebrates; pharmaceuticals; modelling

TU113 Ecotoxicological effects of the insecticide Imidacloprid on amphipods along pollution gradient in a river

V. Svara, Helmholtz Centre for Environmental Research GbR / Effect-Directed Analysis; M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; T. Luckenbach, Helmholtz Centre for Environmental Research UFZ / Department Bioanalytical Ecotoxicology

Many aquatic organisms are sensitive to man-made chemicals in the water. However, some species tolerate the occurrence of toxic chemicals and at the same time benefit from the nutrients that are often abundant in polluted waters. Such is the case for amphipods, which are a key group of species in the aquatic environment. Amphipods are found throughout a pollution gradient of a stream. In our research, we investigated whether *G. pulex* individuals have an ability to adapt to the pollution gradient and to survive likewise in pristine and in polluted sites or whether different conditions select for different phenotypes within the population. *G. pulex* individuals were sampled at different sites along a pollution gradient in the river Holtemme (Lower Saxony, Germany). Individuals were characterized with respect to pollution burden of water and amphipod tissues. Amphipods from three sampling points were brought alive to the lab and exposed to the insecticide Imidacloprid, which was found in water and animal samples beforehand. Lethal time for 50 % (LT50) values were determined and movement activities and moulting rates were recorded. Mortalities in the Imidacloprid treatments clearly differed for amphipods sampled at different sites; animals from more polluted sites were more sensitive to the toxicant and also exhibited reduced movement and moulting activities. We examined whether these differences in toxic sensitivities were related to differences in toxicokinetics of Imidacloprid by quantifying imidacloprid tissue levels after different times of exposure to the compound but toxicokinetics of imidacloprid proceeded similarly in animals from different sites. Population genetics approaches (sequence comparisons of a DNA stretch of the cytochrome oxidase I (COI) gene and comparisons of 9 microsatellite loci) revealed that differences in conditions between sites did not lead to the separation of distinct subpopulations suggesting that survival of individuals at each site is based on individual acclimation and not on adaptation to specific conditions by a distinct subpopulation.

TU114 Antenna Regeneration of the Marine Amphipod Parhyale Hawaiensis as a Possible Endpoint in Ecotoxicology - Preliminary Data

O. Diehl, P. Assano, G. Umbuzeiro, School of Technology, UNICAMP / LAEG; A.M. Soares, University of Aveiro / department of Biology & CESAM; T.H. Miller, Kings College London / Analytical and Environmental Sciences; J. MacRae, The Francis Crick Institute / Metabolomics; N. Bury, University of Suffolk / Division of Diabetes and Nutritional Sciences; S. Owen, AstraZeneca / Safety Health Environment; L. Barron, Kings College London / Analytical and Environmental Science

The (pseudo)presence of emerging contaminants and other organic micropollutants in the environment represents a risk for the organisms that are exposed to them. *Parhyale hawaiensis* experiences a wide range of stressors, including exposure to oil sands deposits that are a source of both physical and chemical stressors to the regional rivers that flow through the deposit. Physical stress on aquatic biota from natural bitumen results from hillslope erosion processes and slumping of material into the rivers, while chemical stress arises from bitumen-derived contaminants entering the waters. To fully understand the ecological and cumulative effects of oil sands mining activities on aquatic ecosystem water quality and associated biological structure and function, there is a need to evaluate the effects of naturally occurring bitumen in the aquatic environment. The main objective of this study was to evaluate the possible ecotoxicological effects associated with the slumping of river bank material (i.e. oil sands deposit that naturally enters the river systems through fluvial geomorphological processes). A series of inter-related laboratory ecotoxicological assays were conducted before and after the slumping of oil sands to the river. A series of techniques was used to measure the overall DNA methylation level as starvation and exposed to different temperatures (8, 12 and 16°C) under different exposure scenarios. However, metabolomics is an emerging field and to interpret the use of metabolite data for the understanding of toxicological responses is challenging. We need to know what is “normal”. The variability in individual metabolomes for a species, or a “background metabolome” should be established to determine possible contributing factors such as stress and moulting (during changes in life stages) that may influence data interpretation. Thus, we have characterised the effect of these factors on the metabolic variability in the freshwater invertebrate, *G. pulex*. Herein, an analytical method is presented for the extraction and non-target analysis of the metabolome in *G. pulex*. Briefly, a dual phase liquid extraction was used followed by HILIC-HRMS to enable detection and annotation of metabolic features extracted from individual animals. Animals collected from the field were analysed immediately and compared to animals that were extracted after a fixed period of acclimatisation to laboratory conditions. The results indicated that sex, moulting stage and acclimatisation period affected the metabolic variability and factors that are likely to influence metabolomic analyses should be investigated to aid understanding of pathways involved in effect-based studies. Furthermore, it may be possible to select and screen animals to create a defined metabolome that may be used to identify adverse effects that may be associated with environmental contaminants. References. 1) Zhang, T., et al. (2012). *Analytical chemistry*, 84(4), 1994-2001. Keywords: metabolomics; invertebrates; pharmaceuticals; modelling

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organism transferred to recipients containing 100 mL salt water and a picture of each organism was taken under an stereomicroscope. Each test consisted of 20 organisms, 10 males and 10 females. During this period, organisms were feed three times a week, the necessary conditions of salinity, temperature, aeration, substrate and luminosity were provided. Four independent experiments were performed. The organisms were monitored during daily until all of them undertook full regeneration. At the end of that time, another picture was taken to determine the difference between the organism length (mm) before and after full regeneration. Assay integration occurred from 7 to 20 days (n=80) after amputation and males and females behaved differently. Males took more time than females to complete regeneration. Length of the regenerated antennae varied from 50 to 80% of the original appendages to both male and female. Next steps will be the exposure of organisms to selected toxicants to assess their absorption process in the developed experimental conditions. Acknowledgements: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq-PVE Process: 400362/2014-7) for funding and PIBIC for undergrad fellowship. Amanda dos Santos e Gabriel Rampazzo Magalhães for technical contribution.

TU115
Added value of community approaches in environmental risk assessment
M. Hammers-Wirtz, T. Strauss, Research Institute gaia / gaia - Research Institute for Ecosystem Analysis and Assessment; A. Toschki, Research Institute gaia
Community studies are an ecologically relevant tool to assess effects of stressors on population and community level. With these kinds of studies direct as well as indirect effects are addressed. Moreover, they allow to assess their absorption process in more realistic and relevant conditions. Furthermore in community studies like aquatic mesocosms, terrestrial model ecosystems (TME) or field studies, a variety of non-standard species interacting with each other and their abiotic environment are included and can be evaluated. Aquatic mesocosm studies have been used as higher tier tool in risk assessment of plant protection products in the EU since the 1990ies. In the last decade, they have been able to be adapted to lower tier studies in order to evaluate some important effects of plant protection products which cannot be covered by the current lower tier studies. However, community tests were often criticised for their high variability and low statistical power. In the last decade, sampling methods have been optimized and a pragmatic approach for risk assessment has been developed to evaluate effects with regard to their statistical power. Furthermore, in the last years there is an increasing concern that current risk assessment is related to a single product while in the environment the populations are exposed to a multitude of different plant protection products. In principle, in those community test systems also multiple mixtures or typical sequences of products can be tested. Due to the characteristic of the current risk assessment procedure sequences of different products are not yet considered. In conclusion, community studies are often noticed only as tools to defend single plant protection products without recognizing their outstanding ecological value. These studies are still the most realistic approach to assess effects on population and community level under realistic environmental conditions. The position and the order of these highly informative studies in risk assessment should be rethought. We suggest further options to integrate community approaches in risk assessment and demand a pragmatic approach and a higher tier testing to get a broader idea about the relevant effects on ecosystem structure and function; 2) as monitoring tool for products which passed risk assessment to check up on community level effects; 3) as monitoring tool for typical sequence scenarios of different products which will be used together in one crop. Here exemplary results of community studies and a screening study will be presented.

TU116
Metal pollution and macro-invertebrate communities in the Olifants River, Western Cape, South Africa
J. Lucas, Cape Peninsula University of Technology / Department of Conservation and Marine Sciences; B.G. Stryman, Cape Peninsula University of Technology / Biodiversity and Conservation; J. Odendaal, Cape Peninsula University of Technology / Department of Environmental and Occupational Studies
Freshwater ecosystems are considered among the most threatened, as a result of current trends in water utilization globally. Within the Western Cape, 76% of rivers are poluted and run the risk of irreversibly losing their ability to support ecosystems. In a toxicological experiment, 50000 fish were exposed to different water quality and quantity. Numerous pollutants result from these activities, with metals being particularly prevalent in most urban rivers. These pollutants are known to affect freshwater macro-invertebrate communities. In South Africa, SASS5 (South African Scoring System for Invertebrates) is a river health index that studies the invertebrate assemblages within specific riverine microhabitats, and can assist in assessing the relationship between water quality and macro-invertebrate communities. The Olifants River in the Western Cape, is not only recognized as a hotspot for freshwater biodiversity, but seen by many, until the previous decade, to be the last pristine river along the South African coastline. It is also one of the three main feeding rivers to the City of Cape Town for fresh water. Despite increasing urbanisation, the last State-of-Rivers Report for this river was published in 2006. It has therefore become crucial to investigate the current degree of pollution within this river, as well as the general integrity of the system. This study aimed to determine the degree of metal pollution along the length of the Olifants River, as well as to investigate the effects of pollution and land use on the invertebrate communities, using SASS5. Water and sediment samples were collected seasonally at 5 sites from upper to lower reaches, acid digested and analysed with an ICP-AES for metal concentrations. Invertebrates were also sampled seasonally, identified and scored according to SASS5 sensitivity scores. An Average Score Per Taxon (ASPT) was calculated for each site. The results showed a general trend of increasing sediment metal concentrations, land use practices and habitat alterations, with concomitant decreasing ASPT’s, from site 1 to site 5, indicating a loss of certain sensitive species at the most impacted downstream sites. Although metal pollution was found to be relatively low, a cocktail of pollutants, coupled with structural alterations, are clearly impacting the health and integrity of this river system. A future study should focus on organic pollutants, as agriculture is one of the main land use practices in the area.

TU117
QWATER - Bioassay integration under the European Water Framework Directive?: A step towards an ecological approach
M. Martinez-Haro, IREC-Instituto de Investigacion en Recursos Cinegéticos / Department of Life Sciences; P. Acevedo, IREC-Instituto de Investigacion en Recursos Cinegéticos; A.I. Pais-Costa, MARE-EBID; L.R. Vieira, ICBAS & CIMAR, University of Porto / Department of Water and Sediment Studies; J.M. Neto, MARE; M. Taggart, University of the Highlands and Islands / Environmental Research Institute; N. Álvarez-Ospina, Universitat Potsdam; L. Guilhaumin, ICBAS & CIMAR University of Porto / Department of Biology; R. Ribeiro, Universidade de Coimbra / Life Sciences; J.C. Marques, TOBEL / Responsible for a complete assessment of water quality status.
The Water Framework Directive (WFD) is the most important piece of water legislation in Europe. It aims at ensuring the ‘good water status’ of EU water bodies and includes both chemical and ecological status. To achieve and assess a ‘good ecological status’, the WFD advocates the integration of various lines of evidence, and demands a set of low-cost tools and techniques to deliver appropriate data. The WFD accounts for chemical and ecological evaluation of water bodies. The requirements regarding the establishment of cause-effect relationships in the assessment of environmental quality. Under this approach, the European Marie Curie QWATER project was aimed to gauge the ecological relevance of integrating short-term toxicity bioassays and biomarkers into quality elements in the WFD, as these may contribute to our ability to assess and manage EU water bodies. Ecologically relevant in situ cost-effective toxicity bioassays were used in a battery of in situ bioassays using representative species for several key functions in the ecosystem. Biomarkers, determined on the individuals used for the bioassays, were also integrated. Principal component analyses (PCA) were performed independently for each source of information, in order to improve the interpretation of the resultant PCA-factors in biological terms, and to verify whether the integration of ‘quality elements’ (bioassays and biomarkers) did (or did not) strengthen the robustness of the standard Ecological Quality Status approach used to assess water quality. Results shown some discrepancies in the water quality determined from each independent factor, i.e., the sampling sites were not equally ordered by all factors. Therefore, only by interpreting the values of all PCA-factors could the WFD provide a more ecologically realistic approach to assess water quality. The European regulatory authorities are presently in the phase of implementing the WFD based on community level approaches all over Europe. Interestingly, bioassays developed here and biomarkers, are available tools to be introduced as new feasible, cost-effective and sensitive protocols in the WFD. It might then become pertinent to stand for the combined/complementary use of ecological indicators and biomarkers, and that the ecological status of EU bodies is assessed using biological indicators and not only chemical specifications. The WFD, as an example of EU legislation in Europe, it aims at ensuring the ‘good water status’ of EU water bodies. Overall, this project allowed us to efficiently contribute to national and international efforts focused in evaluating the water quality in European water bodies.
before test start. In a first step the test conditions were adapted to the requirements of mayfly larvae. Therefore testing of different media was performed. It turned out that, contrary to testing of stonefly larvae, which is performed in Cu-reduced dilution water, moderately hard reconstituted water (according to EPA) works best for testing of mayfly larvae. Instead of Tetramin®, which was used in stonefly testing, the green algae Desmodesmus subspicatus was used for feeding of mayfly larvae. As an additional observation, mayfly larvae were acclimated for 48 hours, the acclimation period was extended to seven days before test start. Under these conditions mayfly larvae showed an acceptable mortality of test organisms. The next step is to perform a test with the test substance Imidacloprid which will be exposed to mayfly larvae for 21 days. Afterwards sensitivity of mayfly and stonefly larvae to Imidacloprid will be compared. The new testing method can provide toxicity data of different aquatic organisms at different aquatic stages, which can be used for a SSD (Species Sensitivity Distribution) approach. The developed test system, the results of the performed tests as well as a comparison between testing of mayfly and stonefly species will be presented.

TU119 Toxicity of a carbamate insecticide on a non-target freshwater gastropod: active ingredient versus commercial formulation
P.Cossi, CONICET - UBA; L.T. Herbert, CONICET - UBA / Departamento de Química Biológica Laboratorio de Ecotoxicología Acuática Invertebrados Nativos.; M. Yuipone, CONICET - UBA / Departamento de Química Biológica Laboratorio de Enzimología, Estrés Oxidativo, y Metabolismo.; J.M. Ríos de Molina CONICET / Departamento de Biología Invertebrados; A. Pradhan, University of Minho / Department of Biology; A. Pradhan, University of Minho / Environmental Sciences School of the Coast and Environment.

Carbamate insecticides are commonly used in agriculture for crop protection exerting their toxicity through the inhibition of the enzyme acetylcholinesterase. In Argentina, the maximum concentration of carbaryl (CAR) detected in surface and subsurface drainages was 45.7 μg L⁻¹. In this study, we evaluated the subchronic toxicity of environmental concentrations of the active compound and a commercial formulation of CAR on biochemical and reproductive parameters in Biomphalaria straminea, a freshwater gastropod native to Argentina. Five treatments were included in this study: dechlorinated tap water, acetone in dechlorinated tap water (solvent control), CAR active compound (dissolved in acetone) in dechlorinated tap water at 12.68 and 126.8 μg L⁻¹, and the equivalent to 126.8 μg L⁻¹ CAR of a formulation (dissolved in dechlorinated tap water) with 85% of the active compound. The concentrations used were so as to have the same molarity as azinphos-methyl, an insecticide previously used in our laboratory. In bioassay 1, eight glass vessels per treatment were used with six snails each. After 14 days of exposure, homogenates were made with the organisms’ soft tissues (pool of five snails per vessel). In the supernatant fraction, the following parameters were measured: cholinesterases (ChE), carboxylesterases (CsE) with two substrates, glutathione S-transferase (GST), glutathione (GSH), superoxide dismutase (SOD) and catalase (CAT). In bioassay 2, containing 50% of the active ingredient versus commercial formulation, 80 snails were used with a single recently-laid egg mass each. The time and success of hatching were registered and, after one month, the survival of the offspring was evaluated. In both bioassays, CAR solutions were renewed every 48 h based on previous stability studies. The active compound caused an increase in the activity of SOD with both CAR concentrations (28 and 83%, respectively, compared to the solvent control). The formulation, being increasing SOD activity (72%), augmented ChE levels by 23% and inhibited CAT activity by 47% (compared to the water control).

Regarding the reproductive endpoints analyzed, no toxic effects were found neither on the primary target, ChE. However, other toxicity pathways, in which antioxidant enzymes are involved, seem to be affected by this insecticide, mainly by the commercial formulation.

TU120 Toxicity of lanthanides to freshwater microcrustaceans
M. Reggiardo, Department of Chemistry and Chemical Physics / Department of Materials and Environmental Technology; A. Lukjanova, H. Vija, A. Kahrul, I. Blinova, National Institute of Chemical Physics and Biophysics / Laboratory of Environmental Toxicology

The application of lanthanides (Ln) in different sectors of the world economy has increased. It is known that Ln are toxic to freshwater crustaceans Daphnia magna (48 h) and Thamnocephalus platyurus (24 h) were performed in synthetic freshwater and natural lake water. Also, long-term (21 days) exposure of D. magna (OECD 211) in lake water was included. It was shown that the Ln fractionation between two main phases (precipitated or settled or remained in the water column) changed during the tests depending on (i) water composition, (ii) nominal concentration, (iii) exposure time, and (iv) tested chemical element. Therefore, nominal concentrations were used for toxicity calculations. Acute toxicity of investigated Ln to both crustaceans was simulated using E(L)C₅₀ values for E. coli, which can be used for a SSD (Species Sensitivity Distribution) approach. The developed test system, the results of the performed tests as well as a comparison between toxicity of mayfly and stonefly species will be presented.

TU121 Relevance and suitability of invertebrates swimming behavior as sub-lethal endpoint to be considered for ecotoxicological investigation
V. Piazza, C. Gambardella, E. Costa, F. Garaventa, M. Faimali, CNR ISMAR

Ecotoxicology is aimed to assess, monitor and predict the effect of contaminants in the environment. Looking for new and alternative approaches in this discipline has become of increasing importance. Furthermore, within the 3Rs approach (reduction, refinement and replacement) the basic idea is to reduce the use of vertebrate organisms and to refine the procedures to minimize pain, suffering, and distress. To achieve this goal, ecotoxicology needs analytical tools, able to detect toxicity at early stages. The swimming speed alteration of marine invertebrates as ecotoxicological endpoint. These data also contribute to support the hypothesis by which behavioral endpoints, such as swimming alteration, represents attractive approach that should be taken into account in ecotoxicological risk assessment.

TU122 Benefits of Using Ecologically and Economically Valued Invertebrate Species for Ecotoxicological Analyses: Potential Phototoxic Effects Comparing a Freshwater Vertebrate and Invertebrate
E.N. Vebrosky, Louisiana State University / Department of Environmental Sciences; W. Xu, Louisiana State University AgCenter / Renewable Natural Resources.; M. Lutz, Louisiana State University AgCenter / Renewable Natural Resources.; K. Armbrust, Louisiana State University / Environmental Sciences School of the Coast and Environment.

In Louisiana, crayfish are not just a standard invertebrate species found in bayous and rice fields but also a staple in the cuisine and culture. Over 82 million pounds of crayfish are harvested annually, resulting in a $45 million industry; therefore, they are both ecologically and economically valued in the region. In 10 years of research, SBR system has proved to be sensitive to a wide range of contaminants, such as metals, organic compounds, micro and nanomaterials, both polymeric and not, and even environmental matrices such as sediment elutriates. The amount of robust and significant data produced supports the suitability of this methodology to be applied to aquatic invertebrates. Here we reported a brief summary of SBR’s applications, which show the relevance, sensitivity and versatility of the swimming speed alteration of marine invertebrates as ecotoxicological endpoint. These data also contribute to support the hypothesis by which behavioral endpoints, such as swimming alteration, represents attractive approach that should be taken into account in ecotoxicological risk assessment.

TU123 Impacts of anti-cancer drugs on freshwater rotifers at environmentally realistic concentrations
N.B. Martins, University of Minho, Department of Biology & CBMA / Department of Biology; A. Pradhan, University of Minho / Department of Biology; F. Cassio,
C. Pascoal, University of Minho / Centre of Molecular and Environmental Biology
CBMA Department of Biology

As human population increases, the presence of emergent chemical contaminants (ECCs) in freshwaters increases. ECCs show to be persistent and bioactive, reaching the freshwater aquatic systems mostly untreated, where their fate and behavior is little understood. Anti-cancer drugs are among the ECCs of concern due to their high cytotoxicity and increasing usage. The administration of drugs in corals, instead of single drug treatment, make the assessment of the environmental risk of these compounds a difficult task with much information lacking on sub-lethal effects on aquatic species. We used two cytotoxic drugs aiming at linking their effects on the reproduction inhibition of the rotifer Brachionus calyciflorus with processes of oxidative stress. The rotifer was exposed to individual concentrations of a non-antimicrobial (5-Fluorouracil, 5FU) and a cytotoxic antibiotic (Doxorubicin; DOX) alone and in mixtures. The results showed that 5-Fluorouracil had a stronger effect (EC₅₀=0.074 mg L⁻¹) on the population growth rate than Doxorubicin (EC₅₀=13 mg L⁻¹) and toxicity effects were detected at environmentally relevant concentrations. Two concentrations of each drug were chosen for binary mixtures and two concentrations per drug were used to assess reactive oxygen species (ROS) accumulation and plasma membrane damage with epifluorescence microscopy. In the presence of low concentrations of SFU, there was a reduction of the toxicity induced by DOX indicating possible antagonistic effects between both drugs. At concentrations, as low as EC₅₀, we found accumulation of ROS in a dose dependent manner showing a clear connection between ROS accumulation and the toxicity of these compounds. Furthermore, this increase in ROS production and the peroxide effect on reproduction, cellular effects were found with possible consequences for the community at the long term.

TU124 Development in vitro and in vivo methods of measuring acetylcholinesterase and general esterases in aquatic invertebrates

Y. Cao, University of Copenhagen / Department of Plant and Environmental Sciences; M. Gottardi, University of Copenhagen / Plant and Environmental Sciences; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences

Quantification of acetylcholinesterase (AChE) and other esterase activities are important in terms of assessing the toxic mechanism of organophosphate and carbamate insecticides. There are several techniques for measuring AChE and general esterases (GE) activity involving spectrophotometric or fluorescence detection of transformation products. In this study, we tested four methods to detect AChE and GE activity in vitro and in vivo in the two aquatic invertebrate species: Daphnia magna and Cercopagisanium marina. In vitro, we used a competitive method (at NG concentration) and an assay using acetylthiocholine iodide as substrate, measuring the production of 5-thio-2-nitrobenzoic acid; 2) AChE assay using acetylthiocholine iodide as substrate, measuring in vitro production; 3) GE-assay using 1-naphthyl acetate (1-NA) as the substrate, measuring 1-naphthol production and 4) GE-assay using 4-methylumbelliferyl butyrate (4-MUB) as the substrate, measuring 4-methylumbellifereone production. Michaelis-Menten curves were created for all substrates, where it was possible. The results showed that the GE-assay using 4-MUB measured general esterase activities well both in vitro and in vivo. The AChE assays using 1-NA and AChE assays using 4-MUB could only be used in vitro, while the AChE-assay using resorufin formation could not be used either in vitro or in vivo. The maximal GE-activities in vitro in D.magna and C. riparius were 345±44 and 151±51 nmol min⁻¹ mg⁻¹ protein, respectively, when using 1-NA and 295±8 and 60±13 when using 4-MUB, hence, showing comparable activities across substrates. Focusing only on AChE-activity in vitro the maximal activities were 13.2±0.3 and 52.3±1.1 nmol min⁻¹ mg⁻¹ protein in D. magna and C. riparius, respectively, making C. riparius the species with the highest activity. Turning to in vivo measurements, the GE-activities were 49.1±4.4 and 17.4±1.7 nmol min⁻¹ mg⁻¹ protein for D. magna and C. riparius. The results of GE-assays using 1-NA and 4-MUB are similar. The AChE-assay could not be conducted in vivo. The GE-assay using 4-MUB, however, could be conducted in vitro as well as in vivo. The GE-activity in D. magna was higher while the AChE-activity in D. magna was lower compared to C. riparius.

TU125 Factors influencing bioaccumulation of metals and pollutants in corals

Y. C. V. de Schryff, North-West University / University Services and Management; H. Kylin, Linköping University / Department of Thematic Studies; Environmental Change; H. Bouwman, North-West University / Unit for Environmental Science and Management

Bioaccumulation is the total accumulation of contaminants in and by an organism from all sources and routes of uptake. Bioaccumulation is normally defined as the sum of the mechanisms of bioconcentration (contaminants obtained from water only), and biomagnification (contaminants obtained from food). Corals pose a conundrum to classifying uptake mechanisms, due to their particular growth forms. Biomagnification in corals can occur through both filter and suspension feeding. It is also known that metals in corals will consistently reflect metallic element composition of the water of a particular area – hence, bioconcentration. Other methods of metal uptake are difficult to assign to one of these categories. Metal particles in suspension in the water are trapped by the defensive mucus layer and ingested by the coral colony as ‘food’. This might be seen as biomagnification. However, biomagnification is traditionally associated with trophic transfer through prey items, and thus the term ‘biomagnification’ does not fit the normal description. In this case, we propose that this route of uptake be called ‘particular vectorial accumulation’. Corals can also include other elements into their skeleton lattice by substitution of Ca²⁺ with other divalent metallic elements. ‘Latticine inclusion’ might be an apt novel term for this occurrence. The crystalline structure of the CaCO₃ coral skeleton differs between hard and soft corals, being either aragonite or calcite. Different metals from different matrices can substitute into the hard skeleton lattice. Small metal particles in suspension can also simply become lodged in the pores and cavities of the skeleton, particularly hard corals, where it may become part of the eventual skeleton by overgrowth. This pathway might conceivably be considered as ‘particulate bioconcentration’. Zoanthellate algae are known to accumulate metals differently from their hosts. We surmise that the intricacy of the symbiosis between algal cells and coral tissue will make it difficult to ascription relative metal contributions (and therefore toxicity) to each of the two symbionts. These potentially different routes of uptake of elements and pollutants may complicate ecotoxicological studies of corals, but may also indicate new avenues of investigation and explanation.

TU126 Survival, metabolic rates and locomotory activities of a groundwater-obligate copepod species under long-term exposures to tetrachloroethylene

T. Di Lorenzo, Institute of Ecosystem Study of the CNR Firenze; L. Piccini, University of Florence, Department of Earth Sciences; D. Galassi, University of L'Aquila; G. Messana, Institute of Ecosystem Study of the CNR; M. Saena, PRIET / CONCET; National University of Luján; W.D. Di Marzo, CONCET / PRIET / TRICTetra-chloroethylene (TCE) is a contaminant frequently found in groundwater of industrialized areas worldwide. The degradation of this chlorinated aliphatic hydrocarbon (CAH) is often incomplete in groundwater and takes several decades. Contamination from TCE is considered persistent and difficult to remediate, due to its high density that favors a gravity-driven vertical infiltration into groundwater bodies. Through means of the Water Framework Directive the European Union has demanded Member States to provide TCE threshold values (TV) for assessing groundwater body quality. In Italy, TCE TV is 1.1 µg L⁻¹ in groundwater bodies. Studies on surface water species have shown that TCE causes oxidative stress in freshwater organisms, however, the impact of this contaminant on the functional behavior of the groundwater-obligate species has not been investigated to date. More importantly, the effect of 1.1 µg L⁻¹ TCE may have on groundwater species under chronic exposures is unknown. In this study, we investigated the effect of 1.1 µg L⁻¹ TCE on survival, oxygen consumption, and locomotory activities of a groundwater-obligate copepod species (Moraria sp.) under different time exposures. The specimens required for the trials were collected in the Antro del Corchia Cave (Tuscany). We measured the individual-based oxygen consumption of this species as a proxy of possible metabolic reactions to long-term (>4 days) exposures to TCE at 8.0°C, i.e. about the mean annual temperature of groundwater in the cave. To this end, we used a sealed glass microplate equipped with planar oxygen sensor spots with optical isolation glued onto the bottom of 80-µL wells (Loïgi Systems, Denmark) and the oxygen consumption was monitored with a microplate reader (Sensor Dish Reader, PreSens, Germany). The system allows simultaneous measurement of 2 replicates and 4 controls. Survival and locomotory activity assessments were performed by counting the number of alive individuals and measuring the number of moving animals in 5 mL glass vials each containing 20 individuals.
the cell, they require a multistep metabolic activation by specific enzymes that participate in biotransformation reactions. The aim of this study was to evaluate biochemical and molecular biotransformation responses of the oyster Crassostrea brasiliana exposed to pyrene (50 mg L\(^{-1}\) and 100 mg L\(^{-1}\)) and fluorene (100 mg L\(^{-1}\) and 200 mg L\(^{-1}\)), after two time periods of exposure (24 h and 96 h). The half-life times of both PAHs were quantified by fluorescence in the aquaria exposure water and the transcriptomic profile of phase I (CYP1-like, CYP2-like, CYP2A14 and CYP156A1-like) and phase II (GST-like, GSTM-like and SULT-like) biotransformation genes, EROD, GST and GSTM activity, were evaluated in gills. The half-life time of pyrene (100 mg L\(^{-1}\) = 2 h and 12 min) in water was lower than fluorene (100 mg L\(^{-1}\) = 5 h and 54 min). These results might be related to the higher lipophilicity of pyrene, facilitating its influx through the plasma membrane into the intracellular space and the activation of its metabolism, leading to its higher bioavailability. This study contributes to the identification of new biomarkers of PAHs contamination in C. brasiliana. Also evidences a possible participation of these genes and enzymes in pyrene biotransformation metabolism. In addition, it suggests the participation of CYP2A14 gene in the biotransformation process of PAHs in gills of C. brasiliana.

TU128 BIOCHEMICAL AND CELLULAR RESPONSES OF THE CRAB PACHYGRUS MARMORATUS TO EVALUATE THE ENVIRONMENTAL CONTAMINATION OF THE LIVORNO HARBOUR (ITALY) AND OF AN ADJACENT MPA

I. Caldani, F. Bellucci, M. Vitale, University of Siena / Department of Earth and Environmental Sciences; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment; S. Fratini, University of Florence / Department of Biology; C. Preti, CIBM Centro Interuniversitario di Biologia Marina; S. Casini, University of Siena / Scienze Fisiche della Terra e dell’Ambiente

The main purpose of the present investigation was to assess the toxicological status of Livorno harbour in Italy and of an adjacent MPA, through the responses of a set of biomarkers in the crab Pachygrus marmoratus. This investigation is part of the IMPACT project (Port Impact on Marine Protected Area: cross-border co-operative actions), which has the purpose to create cross-borderer management plans to actually protect the Marine Protected Areas. Male and female crabs were collected from the different areas: Livorno harbour, considered a polluted area, and the Marine Protected Area, located in the Pelagone phase 1, of the Marine Protected Area Livorno-di Montevago. This study is focusing on the Livorno harbour, where we intended to explore the eventual adverse effects of port contamination. A battery of biomarkers was employed to assess neurotoxic effects (acetylcholinesterase, AChE activity), energy metabolism (isocitrate dehydrogenase), cellular stress (lipid peroxidation, LPO; glutathione S-transferases, GST; glutathione peroxidase, GPX; glutathione reductase, GR; catalase, CAT; glutathione, GSH) and DNA damage (erythrocytic nuclear abnormalities, ENA assay) in the crabs. The levels of trace elements and PAHs were also evaluated in the sampled specimens. Results showed that the crabs sampled at Livorno harbour are exposed to contaminants able to cause oxidative stress and genotoxic effects. LPO and ENA assay showed a statistically significant difference between the crabs sampled at Livorno harbour and those sampled in the MPA. The results trends are not influenced by the stage of the life cycle (24 and 96 h) and SULT-like (24 h) were higher in oysters exposed to pyrene 50 mg L\(^{-1}\). EROD and GSTM activities were higher in oysters exposed to 100 mg L\(^{-1}\) of pyrene (96 h). These results suggest an important role of phase I and II biotransformation genes and enzymes in pyrene metabolism. This study contributes to the identification of new biomarkers of PAHs contamination in C. brasiliana. The results of this work highlight competitive advantages of native species (A. parthenogenetica) from contaminated areas to prevail under the selective pressure of abiotic factors as environmental pollution. Based on these results the highly polluted Odil estuary would not be a refuge for native Artemia species as suggested by the theory of local adaptation. Keywords: Artemia species; Local adaptation; Sublethal exposure; Zinc contamination.

TU131 Comparing interspecific Artemia responses to chronic zinc exposure

A.P. Costa, Marine and Environmental Sciences Centre / Faculty of Sciences and Technology, University of Coimbra; I. Vargo, CSIC / Spanish National Research Council / Biology, culture and pathology of marine species; M. Martinez-Hart, IREC-Instituto de Investigación en Recursos Cinegéticos / Department of Life Sciences; P. Almeida Vinagre, WavEC - Offshore Renewables / Marine Environment and Public Policies; m. sanchez, CSIC / Wetland Ecology

The invasive species Artemia franciscana is displacing native Artemia (A. salina and A. parthenogenetica) from eastern Atlantic coasts and across the Mediterranean region. They are used extensively as prey for marine invertebrates (Swimming Behavioural Recorded e SBR), already to suggest the use of two new invertebrate species of the jellyfish (Scyphozoa) as a representative species when compared to vertebrates (S. c. vulgaris and S. s. frondosus). The aim of this study is to understand if Artemia franciscana is capable of performing better (higher survival and growth) than A. parthenogenetica. Both species experienced significant slower growth and higher mortality when exposed to Zn, but the effects were found in final size. Reproductive parameters, Zn exposure increased offspring production of both Artemia species when compared to control (A. franciscana performs better). However, native Artemia species perform better in reproduction (higher number of broods and offspring production; lower % non-viable nauplii) than A. franciscana. The results of this work highlight competitive advantages of native species (A. parthenogenetica) from contaminated areas to prevail under the selective pressure of abiotic factors as environmental contamination. Based on these results the highly polluted Odil estuary would not be a refuge for native Artemia species as suggested by the theory of local adaptation. Keywords: Artemia species; Local adaptation; Sublethal exposure; Zinc contamination.

TU129 Toxicity of titanium on the mussel Mytilus galloprovincialis

S.T. Costa, Aveiro University & CESAM; R. Monteiro, University of Aveiro, Center for Marine Sciences and are Oceanographic Institute of Aveiro / Biology; R. Freitas, University of Aveiro / Departamento de Biologia CESAM; C. Vale, CILMAR University of Porto; M.E. Pereira, CESAM University of Aveiro / Department of Chemistry

Titanium (Ti) is at forefront of research related to nanomaterials. Due to their physical and chemical properties, Ti nanoparticles (TiNPs) are widely used in aquatic environment. The toxicity of ephyre jellyfish in ecotoxicology. The aim of this current investigation is to suggest the use of two new interspecific Artemia species of the jellyfish Aurelia sp. and Sanderia malayensis as model organisms in ecotoxicological bioassays. A series of experiments were carried out in laboratory controlled conditions, in order to characterize some experimental parameters that can influence the Frequency of sub-lethal endpoints. The use of ephyre jellyfish in ecotoxicology. The experiments allowed to identify endpoint (sub-lethal, frequency of pulsation and acute, immobilization) with different levels of sensitivity and to optimize the use of an automatic recording system of swimming marine invertebrates (Swimming Behavioural Recorded e SBR), already employed with other biological models. In addition, the comparison of the EC50 for Artemia franciscana was performed.
values obtained exposing embryonic jellyfish to different toxic compounds and materials such as nanoparticles and microplastics with those obtained with other marine invertebrates, highlights that epharyngeal are an interesting and promising invertebrate model with a very high ecological relevance to be used in ecotoxicological investigations.

TU132 Paracentrotus lividus and Artemia sp: never too old model organisms to give new end-points
S. Moreaga, C. Gambardella, M. Faimali, F. Garaventa, CNR ISMAR
In the last few years it has become increasingly important the contribution of ecotoxicological assays to the environmental monitoring, as a fundamental indicator of chemical analyses. In environmental risk assessment, in order to fulfill several regulatory requirements, such as the 3R principles (reduction, refinement and replacement), the development of novel approaches to reduce and eventually substitute the use of vertebrate species results to be paramount.

Swimming alteration is one of the most frequently used behavioral responses in aquatic ecotoxicology and its evaluation has proved to be a valuable endpoint in ecotoxicological studies with aquatic organisms. Behavioral responses have proven their usefulness in evidencing impacts of chemicals at environmental concentration that do not necessarily cause mortality; therefore, behavioral endpoints are less invasive than traditional acute tests, but still sensitive and more ecological relevant. In this work, we reported a novel research on the use of swimming behavior of two “old” marine model invertebrates in ecotoxicology, the crustacean Artemia sp. and the sea urchin Paracentrotus lividus. Also we included new compound, mebendazole (an antihelminthic agent) was confirmed to be toxic to swimming alteration test using for the first time sea urchin early stages; ii) a new short-term test based on the evaluation of the swimming speed alteration of Artemia nauplii incubated at 39 °C (± 1) for only 6 hours. Thanks to a modern video-based technology, this study provides novel perspectives and future applications applied to two well-known marine model invertebrates, meeting regulatory and market demands, including the reduction in using vertebrate species and the need for early warning technologies.

TU133 Application of sea-urchin embryo test in the effect directed analysis approach for the evaluation of WWTP effluent in an estuarine media
L. Mijangos, University of the Basque Country UPV/EHU / Department of Analytical Chemistry; M. Krauss, T. Schulze, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analytical; H. Ziarusta, University of the Basque Country UPV/EHU / Department of Analytical Chemistry; M. Olivares, O. Zuloaga, University of the Basque Country UPV/EHU / Plentzia Marine Station (PIE-UPV/EHU) & Dep Analytical Chemistry; r. beiras, University of Vigo / Toralla marine sciences station (ecimat); A. Prieto, N. Etxebarría, University of the Basque Country UPV/EHU / Plentzia Marine Station (PIE-UPV/EHU) & Dep Analytical Chemistry
Since target chemical analysis often cannot explain the cause-effect relationship between certain contaminants and the observed effects in organisms, effect directed analysis (EDA) can be applied to unravel the drivers of toxicity in complex mixtures. In this study, the sea-urchin embryo test (SET) was implemented for the first time in a EDA approach in order to evaluate an estuarine environment influenced by the effluent of the main waste water treatment plant (WWTP) of Bilbao. WWTP sample (225 L) was extracted with SPE and submitted to a Qexactive Plus MS in positive and negative modes for comprehensive analysis. The resulting 15 fractions were also performed by means of UHPLC column, and the resulting 15 fractions were also optimized and improved an automatic recording system, namely Swimming Behavioral Recorder system (SBR), by developing i) a new swimming speed alteration test using for the first time sea urchin early stages; ii) a new short-term test based on the evaluation of the swimming speed alteration of Artemia nauplii incubated at 39 °C (± 1) for only 6 hours. Thanks to a modern video-based technology, this study provides novel perspectives and future applications applied to two well-known marine model invertebrates, meeting regulatory and market demands, including the reduction in using vertebrate species and the need for early warning technologies.

TU134 Plausibility of Daphnia magna model to evaluate eicosanoid pathway related toxicity
S. Lee, Seoul National University / System Toxicology Research Center; M. Cho, Korea Institute of Toxicology; S. Yoon, W. Kim, Korea Institute of Toxicology / System Toxicology Center
Eicosanoids are biologically active, oxygenated metabolites of C20 polyunsaturated fatty acids and are synthesized through cyclooxygenase, lipoxigenase or cytochrome P450 epoxide pathway. As signaling molecules, they are important for diverse physiological systems such as inflammation, allergy, pregnancy, pain perception and blood pressure control. Therefore, they could be the important target for toxicants or drugs such as ibuprofen and aspirin. However, invertebrate model to evaluate eicosanoid pathway related toxicity has not yet been developed well though similar eicosanoid pathway was expected in invertebrate species. Therefore, the purpose of this study was to identify genetic information of key genes of eicosanoid pathway in Daphnia magna, a widely used invertebrate model, and to evaluate the transcription levels of the genes after the exposure to eicosanoid targeted drugs. To this end, we collected amino acid sequences of eicosanoids from other species and then compared the sequences in water flea genome database. After the BLAST and alignment, the genetic information of 10 key eicosanoid genes, such as pla2, cox, pgd2 and pge2, was identified. After that, Daphnia magna was exposed to the eicosanoid pathway targeted drugs, i.e., ibuprofen, indomethacin, celecoxib and acetaminophen at 0.25, 2.5 and 25 μM. Then, we analyzed transcription levels of pla2 gene was commonly down-regulated by all the eicosanoid targeted drugs. Interestingly, some genes, such as pgd2 and gxt1, were responded to certain specific drugs, celecoxib and ibuprofen, respectively. Through this study, we found that the nine of ten genes were expressed by exposure to the eicosanoid targeted drugs in D. magna. We believe that these results partially indicate the plausibility of D. magna as an alternative model organism for evaluating the eicosanoid pathway synthesis. Also, the genes expressed in this study could be used as suitable biomarkers for the eicosanoid related toxicity assessment.

TU135 Responses to single chemical and pulse exposures of two monophyletic Daphnia species under a multi-generation approach
A. Araujo, Universidade de Aveiro / Biologia; A.M. Soares, Universidade de Aveiro / department of Biology & CESAM; D.M. Abessa, Universidade Estadual Paulista - UNESP/CLP / Marine Biology and Coastal Management; S. Loureiro, Universidade de Aveiro / Biology
Planktonic human activities are widespread and exposed to environmental contamination (e.g. industries, agriculture). Those contaminants may have continuous or pulse sources and can affect organisms from natural habitats. In different latitudes even phylogenetically close related species may present divergent chemical tolerance. Therefore, it was used in this study the model species from temperate areas Daphnia magna and the tropical species Daphnia similis. Most studies rely on short term acute and chronic tests. To emerge variability, we performed a chronic multi-generation exposure (nine generations) to lead (0.05 mg/L Pb) under different dietary exposures (regular and restricted) and, regarding chemical mixtures of natural environments, pulse exposures (on Pb acclimated D. magna) was also accomplished. Organisms from F6 were changed to a clean media for recovery for three generations. To monitor acclimation, standard acute immobiliation tests to KCl, CO2 (to check for sensitivity), to the metal Pb and to mancozeb were made. Since size is crucial on organisms’ tolerance, neonates’ body length was also measured. No difference on daphnids sensitivity was spotted among generations, excepting D. similis from recovery period under food restriction. However, Pb tolerance increase is seen on both species. Regarding mancozeb exposure (Pb acclimated), no difference between treatments is seen under regular food. However, opposite outcomes are shown under food restriction, such as D. magna increasing and D. similis decreasing tolerance to mancozeb. Adverse outcomes regarding recovery was shown, D. magna relied on genetic adaptation, since it kept a higher tolerance to Pb, even after three generations under recovery, and D. similis relied on physiological acclimation, being similar to organisms from control treatment. Food restriction also decreased reproduction and increased neonates’ body length (both species). The opposite outcomes under food restriction is crucial regarding natural environments and the natural fluctuating amount of nutrients. Therefore, results indicate that daphnids are capable of acquiring resistance to Pb under a long-term exposure, being an essential data on chemical mixtures contaminated habitats, since their tolerance to other chemicals can vary (as shown for mancozeb). And also, opposite outcomes regarding monophyletic species indicates that it is not accurate to use species from different climates to estimate toxicity.

TU136 Chronic effects of BPA, BPS, and BPSip in Daphnia magna
Y. Hong, B. Jeon, I. Ryoo, J. Lee, K. Ji, Yongin University
Since bisphenol A (BPA) can act as a weak estrogen agonist and disrupt androgenesis, concerns on adverse health effects are increasing. In response to the regulatory pressures to eliminate BPA in plastics, bisphenol S (BPS) and...
4-hydroxyphenyl 4-isopropoxyphenylsulfone (BPSIP) have been frequently used in manufacture of thermal paper and plastic containers. However, there is paucity of information on their chronic toxicity using aquatic invertebrates. In the present study, chronic toxicity of BPA, BPS, and BPSIP were evaluated using Daphnia magna in accordance with OECD Test Guideline 211. The endpoints for the long-term exposure were survival, reproduction, and growth. Compared to the control group, the body length was significantly decreased in D. magna exposed to 1 mg/L of BPA, 5 and 10 mg/L of BPS, and 1 mg/L of BPSIP (<0.05). The results showed that BPA, BPS, and BPSIP could induce endocrine disruption related to the growth in aquatic invertebrates, and the effective concentration of BPSIP was similar to that of BPA. With increasing use of these alternative compounds, more monitoring program in aquatic environment and study of toxicity mechanism appeared to be necessary. Acknowledgement: This study was supported by the National Research Foundation of Korea (Project NRF-2015R1D1A1A01056628).

TU137 Oxidative effects of mono-(2-ethylhexyl)-phthalate on Daphnia magna in both molecular and population level
Y. Ke, KIST Earth & Environmental Safety Group; Y. Seol, KIST-Europe / Environment Safety group
Mono-(2-ethylhexyl)-phthalate (MEHP) is the metabolite of di-(2-ethylhexyl)-phthalate (DEHP), which is widely used in the industry as plasticizers. According to previous studies, DEHP inhibits molting hormone. In addition, MEHP is highly persistent and bioaccumulative in environment and living organisms. In EU, regulation kilo 2008/461/EC on phthalate plasticizers of MEHP acts as a coregulating disrupting chemical in aquatic organism such as Daphnia Magna. The aim of this study was to elucidate the linkages between toxicity test result and oxidative stress of MEHP. We studied the effects of oxidative stress as molecular initiating events on Daphnia magna. We observed the changes in different levels of the lipid peroxidation, glutathione S-transferases (GSTs), catalase (CAT) and superoxide dismutase (SOD) in the treated daphnids. This study showed the molting rate, reproduction rate and growth of daphnids during chronic (21 d) test in order to link the activities of reproduction system to antioxidant responses. Further study is needed to clarify how MEHP leads to dysfunction of endocrine system of Daphnia magna.

TU138 Are Daphnia magna and Chironomus riparius acute responses comparable?
B. Ponti, ChemService Srl; R. Bettinetti, University of Insubria / DISTA; D. Garagna, ChemService srl.; F. Casarotto, University of Insubria; M. Neri, ChemService srl - Controlli e Ricerche
Laboratory ecotoxicity test results predict the responses of organisms with varying degrees of accuracy. Traditionally, the acute toxicity on aquatic invertebrates is estimated by exposing for 48 hours young cladocerans of Daphnia magna (OECD test guideline n. 202, 2004), taking advantage of its well-experienced sensitivity and reliability for a huge number of known and unknown toxicants. The 48 hours test on Daphnia magna conducted according to OECD 202 is listed as a data requirement in EU LCLPD Act 2000/2013 on phthalate plasticizers of MEHP as well as in Reg EC 1907/2006 on chemicals (REACH). In recent years even the use of first instar larvae of Chironomus riparius (Insecta, Diptera) has been proposed (OECD test guideline n. 235, 2011) to be used to complement existing Test Guidelines for chironomid chronic toxicity assays (OECD test guidelines 218, 219, 2004) (OECD Test Guideline n. 233, 2010). Chironomus riparius is generally used to test the quality of aquatic daphnids (SOD) in the treated daphnids. This study showed the molting rate, reproduction rate and growth of daphnids during chronic (21 d) test in order to link the activities of reproduction system to antioxidant responses. Further study is needed to clarify how MEHP leads to dysfunction of endocrine system of Daphnia magna.

TU139 Analysis of mixtures of bisphenol A and UV filters Octocrylene and OD-PABA on Chironomus riparius using a specific RT-PCR array
A.M. González, UNED / Mathematical Physics and Fluids; J. Martínez-Guitarte, UNED / Física Matemática y de Fluidos
Ana-Belén Muñiz-González, José-Luís Martínez-Guitarte, tUrGlobo de Biología y Toxicología Ambiental. Facultad de Ciencias, UNED. Madrid (Spain)Keywords: UV filters, BPA, RT-PCR array & The ultraviolet (UV) filters are main components of many personal care products (PCPs) that are extensively used. They are organic compounds defined as emergent contaminants, which are increasing their presence in the environment because their use in recreational and industrial activities. Described as endocrine disruptors in vertebrates, their effects on invertebrates have been poorly studied, especially in mixtures. On the other hand, Bisphenol A (BPA) is as plasticizer used in packaging and other industrial products with confirmed endocrine disruption activity. In this study we have used two common UV filters, octocrylene (OC) and 2-ethylhexyl 4-dimethylaminobenzoate (OD-PABA), and BPA to mimic the putative mixtures resulting from PCP and interacting with plastic of PCP containers. These mixtures were reach the biota of freshwater ecosystem so the main objective was studying of the effects that the mixtures can have on an invertebrate with a relevant role in the food chain of these ecosystems, Chironomus riparius. C. riparius is a dipteran with aquatic larvae frequently used in toxicity tests. Fourth instar larvae were exposed for 24 hours to single compounds and to binary and ternary mixtures. Effects were measured by retrotranscription and Real-Time PCR using a specific array covering a number of relevant metabolic pathways like endocrine system, immune response, stress response, detoxification mechanisms and apoptosis among others. Using an array could improve the toxicological evaluation of the cellular effects of the compounds favoring the identification of new molecular biomarkers useful for ecological risk assessment and toxicity tests. The methodology used in the design of the array can be used with other species improving also our knowledge about the mode of action of these compounds. This work has been funded by the Ministerio de Economía y Competitividad, CICYT (SPAIN), CTM2015-64913-R/a.B.M.G is the receiver of a pre-doctoral contract from the National University of Distance Education (UNED).

TU140 Genetic variability in tolerance to microbial insecticides in Chironomus riparius
M.D. Bordalho, University of Aveiro; A. Rodrigues, University of Aveiro / Biology Department & CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; J. Pestana, CESAM & University of Aveiro / Biology
Natural populations are constantly facing a large array of environmental stressors, from both natural and anthropogenic origin, which represent a strong selective force shaping the behaviour, physiology and morphology of organisms. Genetic diversity acts as a key component of adaptation and can influence the potential to adapt to changing environmental conditions. Ecological risk assessment needs to couple quantitative genetic analysis with ecotoxicological studies in order to understand the mechanisms underlying evolution of tolerance. Research on genetic variation regarding tolerance to contaminants has been mostly performed with clonal lineages. An alternative methodology has been applied for sessile microorganisms producing, insecticides, providing sensitivity to insecticides (genotypes) and estimating genetic variation in fitness traits. However, additional environmental stressors are not usually considered, limiting the predictive capabilities and determination of tolerance costs across different scenarios. The aim of this work was to assess genetic variation in tolerance in the aquatic insect Chironomus riparius exposed to microbial insecticides. A C. riparius population was established in the laboratory by crossbreeding five populations, in order to ensure sufficient levels of genetic diversity. By employing a full-sib family split design, this study presents a quantitative genetic analysis among families of C. riparius across different environments (microbial insecticide exposure under two levels of salinity). Each egg mass was considered a single family (full-sib genotype). Within each family, larvae were randomly allocated to all treatments. Emergence rate, time to emergence and imaginal weight were used as responses. Relationships between genetic variation, life-history traits and fitness costs in response to microbial insecticides, and the potential of a key aquatic insect species to evolve tolerance to these compounds will be discussed as well as an evolution of disease resistance on aquatic species. The study also highlights the suitability of C. riparius, a model organism in aquatic toxicology, for quantitative genetic analyses.

TU141 Effects of Amitraz on Chironomus riparius: life history and biochemical responses
H.R. Monteiro, University of Aveiro / Department of Biology and CESAM; J. Pires, Department of Biology & CESAM & University of Aveiro / Biológia de Reservatórios, Polytechnic Institute of Leiria / MARE IPLeiria; A.M. Soares, University of Aveiro / department of Biology & CESAM; B. Devreese, Ghent University / Laboratory for Protein Biochemistry and Biomolecular Engineering; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria
Amitraz is a very effective formamidine insecticide used in agriculture to control flying insect pests. However, there are concerns about the potential of considering environmental stressors, not usually considered, limiting the predictive capabilities and determination of tolerance costs across different scenarios. The aim of this work was to assess genetic variation in tolerance in the aquatic insect Chironomus riparius exposed to microbial insecticides. A C. riparius population was established in the laboratory by crossbreeding five populations, in order to ensure sufficient levels of genetic diversity. By employing a full-sib family split design, this study presents a quantitative genetic analysis among families of C. riparius across different environments (microbial insecticide exposure under two levels of salinity). Each egg mass was considered a single family (full-sib genotype). Within each family, larvae were randomly allocated to all treatments. Emergence rate, time to emergence and imaginal weight were used as responses. Relationships between genetic variation, life-history traits and fitness costs in response to microbial insecticides, and the potential of a key aquatic insect species to evolve tolerance to these compounds will be discussed as well as an evolution of disease resistance on aquatic species. The study also highlights the suitability of C. riparius, a model organism in aquatic toxicology, for quantitative genetic analyses.

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the most sensible endpoint (LOEC of 40 g L⁻¹). Short-term exposures (48 h; 0, 10, 40, and 160 g L⁻¹) to amitraz induced glutathione peroxidase activity and a decrease in catalase activity. Additionally, amitraz exposure caused a decrease in lactate dehydrogenase activity and a significant increase in electron transport system activity, both energy metabolism associated biomarkers. Regarding oxidative damage biomarkers, lipid peroxidation increased in C. riparius larvae exposed to 100 mg/kg, while there was a significant decrease in DNA damage levels at 10 and 40 g L⁻¹ treatments. The current results reveal possible biochemical targets of amitraz toxicity and suborganismal responses associated with amitraz exposure. The assessment of biochemical biomarkers may support the interpretation of toxic responses observed at organism level and therefore in the assessment of the ecological effects of environmental contamination. Moreover, it increases the information available on the outcomes of amitraz exposure in freshwater invertebrates, and underlines the importance of risk assessment studies of formamidine pesticides. Acknowledgements: This study had the support of the Fundação para a Ciência e a Tecnologia through project PROTEOME (PTDC/AAG-MAA/1302/2014), co-financed by COMPETE (POCI-01-0145-FEDER-16773).

TU142 Multigenerational exposure of Eisenia fetida coelomocytes to copper agrochemicals: conventional and nano-pesticides

C. Malheiro, Department of Biology, University of Aveiro / Biology; A. Rita, University of Aveiro / Dept of Biology & CESAM; D. Nunes Cardoso, CESAM, University of Aveiro / department of Biology & CESAM; T. Neves, National University of Singapore / Zoology and Animal Cell Biology; I. Garcia, University of the Basque Country / Zoology and Animal Cell Biology; A. Urionabarrenetxea, University of the Basque Country / Zoology and Animal Cell Biology; F. J. Wronowski, University of Aveiro / Department of Biology & CESAM; G. Mainardi, Vrije Universiteit / Ecological Science; L. P. Figueiredo, University of Aveiro / Dept.of Biology

Effects of multiple environmental stressors on Eisenia fetida coelomocytes: by assessing how those stress scenarios pose changes in ecosurviences are subjected to multiple environmental stressors (i.e., temperature raises, longer exposure times and higher complexity of stressor interactions) and to mechanistically underpin increased toxicity levels caused by the tested stressors (increase in temperature, low OM content 6% vs. 10%, thermal stress (19PC vs. 260C) under standard OECD conditions (Cd: 5.25 mg kg dw.-. Ag NPs: 0-100 mg kg dw.) in OECD soil during 3 days. After exposure of earthworms, coelomocytes were retrieved and viability was assessed in microplate through Calcein AM assay. In addition, flow cytometry analysis was used to determine mortality of coelomocytes and changes in the relative proportion of amoebocytes/eleocytes. Coelomocytes extruded from earthworms maintained low and high temperature showed a decreased cell viability, but no changes were recorded in the relative proportion of amoebocytes and eleocytes. Exposure to Cd provoked higher mortality in eleocytes while Ag NPs caused more mortality in amoebocytes. Thus, we can conclude that the response of the different subpopulations was dependent on metal form and was enhanced by environmental factors (increased temperature and low OM). These results reinforce the potential of using coelomocytes as a bioindicator to assess soil health assessment in a global warming scenario. Acknowledgements: Basque Gov (IT810-13); Univ. Basque Country (UFI 11/37) and MINECO (Nanosilveromics ProJ).

TU144 Toxicity of abamectin and difenoconazole, pure and formulated, to Folsomia candida

J. P. Figueiredo, University of São Paulo USP; G. Mainardi, Vrije Universiteit / Department of Ecological Science; C. Lima, Vrije Universiteit Amsterdam / Animal Ecology; E. Espindola, University of São Paulo USP / Hydraulics and Sanitation; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science; D. Rebolfs, Vrije Universiteit / Department of Ecological Science

The progressive increase in the use of pesticides has been accompanied by effects at different levels of biological organization, implying losses of species and consequently of ecosystem services. Among the species utilized in terrestrial ecotoxicological tests, the springtail Folsomia candida (Collembola, Isotomiidae) is one of the species suitable for assessing side-effects of the most used pesticides. In Brazil, the acaricide abamectin and the insecticide difenoconazole are widely used in agriculture, but little data is available about their possible side effects on the soil community. The objective of this work therefore was to evaluate the effect of abamectine, pure and in the formulation Kraft, and of difenoconazole, pure and in the formulation Score, on the reproduction of F. candida using a standard OECD Lufa 2.2 soil. Juvenile F. candida, with age 0-12 d, were exposed following the standardized ISO and OECD test guidelines. The results were analyzed by analysis of variance (ANOVA) followed by Dunnnett's test at 5% significance level. Median lethal concentration (LC₅₀) was calculated using Trimated Spearman Karber (TSK) and EC₅₀ and EC₉₀ values for effects on reproduction were estimated using a logistic model. The results showed that both pesticides were more toxic in the formulation than when applied as pure active ingredient. For abamectin dosed as the formulation Kraft EC₅₀ was 1.0 (0.17-1.8) mg/kg dry soil, while it was 6.3 (1.8-11) mg/kg dry soil for the pure active ingredient. For difenoconazole applied as the formulation Score EC₅₀ was 53.5 (40.0-67.0) mg/kg dry soil while no effects on springtail reproduction were seen at concentrations of the pure active ingredient up to 333 mg/kg dry soil. The data indicate that it is essential to perform official formulation testing with tests on pure active ingredients. It is currently unknown which component of the formulation causes the increased toxicity. Therefore, we are applying gene expression analyses to mechanistically underpin increased toxicity levels caused by the tested formulations.

TU145 Terrestrial arthropods as indicators of environmental pollution

V. Lesch, North-West University; H. Bourman, North-West University / Unit for Environmental Science and Management

In recent years, the use of and interest in terrestrial arthropods as indicators of environmental pollution has increased. Arthropods are widely used in agriculture, with over 31,000 species described. Terrestrial arthropods are relatively easy to sample, and collection normally has less ethical restrictions than for higher animals. We reviewed the literature. We found relatively few general studies on arthropods as indicators of environmental pollution. However, those that did worked on spiders, bees, earthworms and ants. In addition, most studies favoured predatory species, since they are more sensitive and can give insights into ecosystem functioning in the area. In most studies, the sampling sites were close to old mines, or the studies were comparisons of arthropods from different locations. Published literature on terrestrial arthropods not only focuses on whole body utilization but also organ specific studies, as well as research on the use of arthropod products (such as honey and spider webs) as matrices for analyses. Most arthropods have a close association with soil, foliage, and air, representing pollution concentrations in the immediate environment. Each arthropod species occupy a unique niche and in doing so represent the concentration or degree of pollution in different ways. Each species, therefore, indicates pollution from different perspectives. However, there is still a need for more ecological relevant evaluations of environmental risk associated with chronic exposure to soil agrochemicals.
The impact of chlorpyrifos and its formulations on the acetylcholinesterase activity in non-target soil organisms

D. Grasso, E. Corsi, University of Siena / Physical, Environmental Sciences; I. Corsi, University of Siena / Physical, Environmental Sciences; E. Conti, University of Catania / Department of Biological, Geological and Environmental Sciences; G. Liberatori, G. Protano, F. Nannoni, University of Siena / Department of Physical, Earth and Environmental Sciences; G. Costa, University of Catania / Department of Biological, Geological and Environmental Sciences; S. Corsi, University of Siena / Physical, Earth and Environmental Sciences

The Ecological Risk Assessment of pesticides requires data regarding their effects to terrestrial non-target species. Commercial pesticides formulations, however, contain a significant proportion (> 90%) of so-called inert ingredients, which may greatly enhance or lessen the toxicity of a formulation. Chlorpyrifos is a broad-spectrum organophosphate insecticide that is used globally for crop protection and pest control and as many other active ingredients of pesticides is applied formulated into a suitable product. The objective of this study was to investigate the impact of the technical active ingredient (a.i.) chlorpyrifos and its four commercial formulations (Durban®@ 480 EC, Pyriximes® @ 480 EC, Pyrix® @ 480 EC, Nurelle® D) on the acetylcholinesterase activity in snail Helix aspersa and earthworm Eisenia andrei. The difference in sensitivity of tested organisms towards above mentioned pesticides was assessed by the in vitro exposures at range of concentrations 5-300 µg/L. Issue in the different fractions of organisms homogenate (head and haemolymph in snails; head and whole body in earthworms). The data from the in vitro study with the technical active ingredient and formulations showed AChE inhibition in a concentration dependent manner. The most sensitive responses to pesticides formulations exposures were found in H. aspersa haemolymph and E. andrei whole body homogenate. Among the tested pesticides, the inhibitory effect (based on the IC50s comparison) increased in the following order: a.i. < Nurelle® < Durban® < Pyriximes® < Pyrix® (earthworm head/tissue a.i. < E. andrei, Nurelle® < Pyrix®). Small haemolymph’s samples. This study showed that the formulated pesticides caused significantly higher AChE inhibition compared to the technical a.i. in both model organisms. The data suggested that the in vitro exposure studies have predictive value for sensitivity to insecticides. Risk assessment based on the on active ingredient toxicity might not be sufficient and toxicity testing of both environmental formulation provide more realistic reports on the overall ecotoxicological impact of pesticides on sensitive non-target organisms. Keywords: chlorpyrifos, acetylcholinesterase, non-target organism, pesticide

Ariadna spider as a good candidate bioindicator of heavy metal contamination in the Namib Desert

E. Conti, University of Catania / Department of Biological, Geological and Environmental Sciences; G. Liberatori, G. Protano, F. Nannoni, University of Siena / Department of Physical, Earth and Environmental Sciences; G. Costa, University of Catania / Department of Biological, Geological and Environmental Sciences; S. Corsi, University of Siena / Physical, Earth and Environmental Sciences

Human activities are strongly affecting natural ecosystems and native species have been proposed as bioindicators for pollution monitoring and assessment. The present study is the first attempt to use Ariadna spiders as indicators of trace metals contamination in the Central region of the Namib Desert. Mining activity is the biggest contributor to Namibia’s economy in terms of revenue and several trace elements as well as semi-precious gemstones and minerals are main products. Therefore, their released and potential contamination of specific Namib mining areas cannot be excluded. Various spider populations belonging to undescribed Ariadna species are widespread in gravel plains within the Central Namib Desert. Being sit-and-wait predators, Ariadna spiders spend their life in individual tunnels dug in the soil, so resembling the behaviour of ground-dwelling spiders known to be strong metal accumulators in terrestrial ecosystems. In the present study, we collected 60 specimens of three Ariadna populations (20 spiders from each site) in austral summer 2016, along a N/S and W/E transect at various distances from main mining areas of the Namib Desert. Depth and diameter of entrance burrow and body width of each spider were recorded. Trace metals analysis were conducted in spider’s whole body as well as in soils samples collected around spider’s burrow. Oxidative stress parameters, CAT, GST and MDA were analysed in soft tissue of spider’s whole body as well as in soils samples collected around spider’s burrow. On the opposite levels of Pb, V, Cr, Co and Ni were 1 or 2 order of magnitude lower in spiders than in soils. Similar trends in such levels and biological responses as CAT, GST and ChE were observed among sites and based on various distance from the mining area. Such preliminary results support the recognition of Ariadna spider as a good candidate as bioindicator of trace metals contamination in Namib Desert.

Effect of spray drift reduction techniques on pests and predatory mites in orchards and vineyards

D. Formasiero, N. Mori, P. Tirello, A. Pozzebon, C. Duso, University of Padova / DAFNEA; E. Tescari, Dow AgroSciences Italia srl; R. Bradascio, Dow AgroSciences Italia srl / RD; S. Otto, Italian National Research Council Spray drift of pesticides has a negative impact on aquatic ecosystems and the environment, including damage to non-target organisms. Particularly, the drift of some insecticides can have detrimental effects on beneficial arthropods such as predatory mites. According to recent EU Directive, the reduction of spray drift is required for a sustainable use of pesticides, yet without reduction of efficacy against pests. In this framework, eight field trials were conducted from 2012 to 2014 in two typical growing areas of Verona district (Northern Italy), four on apple orchards and four on vineyards. The aim of these trials was to evaluate, for two spray drift reduction techniques: 1) the spatial patterns of in-field droplets, 2) the efficacy agrochemicals-resists on apple pests (Cydia pomonella and Lobesia botrana respectively), 3) the side effects on predatory mite populations. Four insecticides: chlorpyrifos, chlorpyrifos-methyl, methoxyfenozide and spinetoram, were applied with three different spraying techniques: high-drift nozzles (Albuz, ATR 80), low-drift nozzles (Albuz, TV1 80015 green), and high-drift nozzles with an anti-drift adjuvant (rapseed oil). Results showed that the two spray drift reduction techniques effectively increased droplets amounts next to sprayer, reducing potential drift on both apple orchards and vineyards and were generally as effective as standard nozzles without additional side effects on beneficial arthropods. Results suggest that the use of spray drift reduction techniques such as low-drift nozzles and anti-drift adjuvants can be effective in managing key pests and also in decreasing the environmental impact of using insecticides. Full article in: Crop Protection 98 (2017) 283-292, DOI:10.1016/j.cropro.2017.04.010.

Microplastics in freshwater and terrestrial systems - fate, monitoring, and biological interactions

S. Kim, Y. Chae, D. Kim, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

The plastics are slowly weathered into nano- (< 100 nm) and micro- (< 5 mm) sized particles owing to physical, chemical, and biological processes in the environment. In this study, we observed the behaviour of freshwater organisms and evaluated whether they recognize and respond to microplastics. Adult zebrafish was exposed to the different concentration of microplastic (MP, 250-300 µm) and food materials (F) 20 mg MP, MP20, 20 mg F, F20, 10 mg MP + 10 mg F, MP10F10). The behaviour patterns were recorded and quantified. Diving beetle fed the adult zebrafish, which exposed under MP10F10 and F20 conditions, and the ingestion rate was quantified. The number of capturing patterns were counted as 21±4, 8±5, and 14±3 under F20, MP20, and MP10F10 conditions, meanwhile the spitting patterns were determined as 0±0.6, 2.8±1.3, and 3.2±0.4, respectively. Ingestion rate of diving beetle on control group was calculated 0.63±0.10 zebrafish wet/mg/sec. The exposure group, which fed the MP10F10 exposed zebrafish, showed the significant decreasing (p < 0.05) of ingestion rate (0.55±0.08 zebrafish wet/mg/sec) during 59±1±55 seconds. On diving beetle, the MP were fully found at crop organ until 720 min after ingestion, and did not transfer to another organ. The digestive organs, especially crop, seemed to separate the microplastic as indigestible food. We concluded that the freshwater organisms recognize the microplastic, and exhibit the defence behaviour. This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT, and future planning (2016R1A2B3010445).

Microplastic shedding from functional textiles

C. Bossinger, Swerea IVF Swedish Research Environment; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); P. Mellin, Swerea KIMAB AB; O. Levenstein, University of Borås; A. Hanning, Swerea IVF AB; S. Roos, Swerea IVF AB / Energy and Environment

Microplastic pollution of marine environment is an environmental issue which is intensely discussed on a global level. Synthetic based textiles contribute to microplastic pollution of the marine environment. Besides littering and the size-shape effects that microplastics have when being exposed to humans and animals they provide an additional vector for chemical pollutants, i.e. possibly providing a new entering mode into organisms of pollutants already existing in the sea. But fibers generated from consumer articles such as textile garments might carry chemical pollutants due to different chemical treatments. This study investigated (PA) fiber loss and polyester/cotton blend (PES/CO) textiles that were functionalised with durable water repellent (DWR) treatment. The chemical treatment consists of polymers that are based on per- and polyfluoralkyl substances (PFAS). Question 1: Do we have release of fluorinated fibers from functional textiles? Question 2: What is the amount of fluorinated fibers lost during the washing which can have an impact on the environment? The microscopic investigation identified the corresponding fiber fragments during the simulation of industrial washing (Gyro wash). Fiber fragments were identified with REM and the EDX analysis of showed fluorine (F) as part of the fiber surface.
ecotoxicity data is now available to begin building species sensitivity distributions. Where effects/no currently detected in the environment are few are inconclusive due to flaws in the experimental design and interpretation. This suggests that the fiber substance composition confirmed that these fibers still contained traces of the functional DWR treatment. Released into the environment these fibers might be exposed to long term degradation processes which would finally cause the formation of persistent environmental pollutants. In addition the results of this study suggest that similar mechanism might be relevant for textile containing other functional coatings such as flame retardants, softeners or dyes as well.

TU152

Wastewater below the non-tolerable pathways of microplastics into the environment. Microplastic enters the wastewater e.g. as an ingredient of cosmetics or from specific pharmaceutical applications. Wastewater treatment plants (WWTPs) are generally considered to remove microplastic from the wastewater stream and to protect the receiving river. However, there is not much information to prove this assumption experimentally at environmentally relevant concentrations. This is due to the lack of so far detection in sludge matrices. Organic polymers in a complex sludge matrix at such low concentrations. In view of these limitations, the aim of this work was to determine the fate of a model polymer, crosslinked polystyrene sulfonate (PSS), in a simulated WWTP using radiolabeled material. PSS is a polymer which is widely used as an ion exchange resin in various applications. The polymer is insoluble in water and is not degraded in the human body. Calcium loaded PSS (CaPSS) was synthesized in a procedure downscalable from an industrial method with 14C-radiolabelled styrene monomer. This is a key step in the entire project as the radioactivity of the monomer interferes with the polymerization reaction. The resulting 14C-polymer was characterized by comparison with commercial non-labelled CaPSS to prove success. The 14C-radiolabelling enabled detection in sludge matrices as well as the validation of potential water soluble degradation products and 14CO2 from mineralization. A mass balance was established to identify the most relevant processes for the fate of CaPSS in WWTPs. Due to the high sensitivity of 14C-detection, the test can be performed at realistic/environmental relevant concentrations. As the detection limit of 14C-microplastic in environmental matrices is currently orders of magnitude below the non-tolerable pathways of microplastics into the environment, this study can serve as an example how future studies on the general topic “microplastics in the environment” can be supported.

TU153
A cost-effective methodology for separation of microplastics from freshwater systems M. Rodrigues, Department of Biology & CESAM - University of Aveiro / Department of Biology; F. Gonçalves, University of Aveiro / Department of Biology and CESAM; H. Nogueira, Universidade de Aveiro / Department of Chemistry; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University; A.M. Gonçalves, MARE, Dep. of Life Sciences, Coimbra University/Biologia Department & CESAM, Aveiro University; N. Abrantes, University of Aveiro / CESAM; M. Bochow, Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences; F. Siegert, Ludwig Maximilians University of Munich / RSS Remote Sensing Solutions GmbH; M. Höbel, Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences; A. Boxall, University of York / Remote Sensing Solutions GmbH; M. Bochow, Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences; A. Boxall, University of York

Microplastics, one of the most demand material worldwide, are considered one of the most emerging aquatic pollutants due to their ubiquity, high persistence and insufficient management. Especially, microplastics (5-500 µm) are of scientific and social apprehension as they can reach high densities, derive from a variety of sources and can interact with biotic and abiotic environment. Currently, the concerning about the occurrence of microplastics (MPs) in freshwater systems has been increasing, notwithstanding there is no unified method for MPs separation in these systems. This result in inaccurate data that differs in quality and resolution, not allowing data comparison between different studies (large-scale spatial and temporal comparisons). Hence, this work aims to assess the effectiveness of distinct separation methods as an attempt to identify and establish the most cost-effective technique. For that, artificial samples containing eleven plastics belonging to the most common types of polymers (e.g. low/high-density polyethylene, polypropylene, polystyrene, polyvinyl chloride, polyethylene terephthalate) were prepared (secondary MPs) and subjected to distinct methods. These methods included density separation methods using sugar, olive oil and zinc chloride, as well as organic matter degradation methods using hydrogen peroxide (peroxo oxidation) and multifunctional enzymatic digestion (enzymatic digestion). The samples were then undergoing the detection, quantification and identification of polymers using a dissection microscope and Fourier transform infrared spectroscopy (FTIR). Several criteria were considered in order to achieve the aims of this work: efficiency of density separation and organic matter degradation, total mass of recovered microplastic (primary and secondary), cost of each method, the simplicity and the quality of recovered polymers. Based on this multi-criteria approach, this study concludes that the wet peroxide oxidation with addition of zinc chloride was the most cost-effective method. This method should be used in future studies of quantification of MPs in aquatic systems, notwithstanding the use of hydrogen peroxide must be cautious and only applied when necessary.

TU154
Applicability of remote sensing methods for indirect mapping of microplastic distribution within aquatic ecosystems S. Piehl, University of Bayreuth / Department of Animal Ecology I; E.C. Atwood, RSS Remote Sensing Solutions GmbH; M. Bochow, Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences; A. Boxall, University of York / Remote Sensing Solutions GmbH; F. Siegert, Ludwig Maximilians University of Munich / Department of Biology; C. Lafaor, University of Bayreuth

Recently, there have been intensified research efforts to get reliable information about sources, sinks, and transportation pathways of microplastic in aquatic environments. Due to the high spatiotemporal variability of these systems, our knowledge of those aspects is still limited. Earth remote sensing is a key technology within the field of environmental monitoring, providing a unique tool for large area observations of water parameters such as suspended particulate matter, chlorophyll-a or colored dissolved organic matter. Since floating microplastic is probably influenced by the same transport mechanisms as non-motile plankton or marine debris, we tested the hypothesis of a correlation between microplastic and specific water parameters. In situ water parameters, microplastic (5mm – 250 µm), and in situ derived spectral reflectances measurements (AIS FieldSpec) were taken during field campaigns at three different river mouths (Trave and Elbe in Germany, Po in Italy). Microplastics from surface waters were sampled with a manta trawl. Organic material was removed by enzymatic digestion and wet oxidation, and the remaining microplastics were analyzed down to plastic type with FT-IR as well as SWIR spectroscopy. Initial regression analysis results comparing microplastic with water parameters will be presented, and their suitability as indicators for microplastic abundance is discussed. Furthermore, simultaneously obtained remote sensing data for the river Elbe will be linked with in situ derived microplastic data and water parameters. If significant relationships between microplastic and water parameters exist, remote sensing of water parameters as an indicator for microplastic abundance would provide a cost-effective monitoring tool, able to cover much larger areas than feasible with ship-based point measurement.
Coastal accumulation mapping of microplastic particles emitted from the Po River, Italy: Integrating remote sensing, in situ sample collections and ocean current modelling


Plastic pollution in inland waters and the open ocean is a long recognized problem for marine life, coral reefs, the fishing industry and shipping transport safety. Microplastics, defined as particles < 5 mm, form a considerable portion of this pollution and have recently received increased public attention following recent discoveries that not only can these particles be ingested by planktonic animals, but also outnumber natural food items in some ocean areas. Ingested particles can induce negative survival effects as well as serve as introduction vectors for accumulated persistent organic pollutants (POPs) or carcogenic plastic additives into the base of the food chain, potentially leading to many seafood products consumed by humans. Research has mainly concentrated on marine systems, and while a growing number of studies focus on freshwater lakes, river systems have to date received little attention. In particular, riverine plumes as an important influencing factor for the input and distribution of microplastics into coastal ocean areas remain largely unexplored. Here we present a study of the accumulation of microplastic particles emitted by the Po River along the Adriatic coastline in northern Italy. We posit that river-induced coastal microplastic accumulation can be predicted using a hydrodynamic model, supported by remote sensing data from Landsat and Sentinel-2A. Model accumulation maps were validated against in situ samples collected at 9 beaches in 2016, of which more than 95% were post-consumer. Hydrodynamic modelling suggests that the amount of discharged particles is only semi-coupled to beaching rates. Object tracking revealed that beaching of emitted particles was strongly dependent and relatively low (less than 25% of all released particles from a given river mouth), primarily occurring within the first five days. The southernmost Po River mouth posed an exception, where more released particles (94%) were found to beach over an extended period of time and along a longer stretch of coastline. Comparison with remote sensing based accumulation maps and validation against in situ beach sampling are discussed. The presented methodology lays the groundwork for developing an operational monitoring system to assess microplastic pollution being emitted by a major river and its distribution along adjacent coastlines as well as into the open ocean.

cause and effect of the plastic industry in South Africa as a developing country

C. Verster, North-West University - School of Biological Sciences / Environmental Science and Development.

In 2017, the South African plastic industry has grown with 1.9%, compared with 2016 (Plastics SA). Although legislation is in place to promote recycling and sustainable use of natural resources, the recycling of plastic based materials are done predominantly by corporate initiative. Many South Africans believe that the country is lagging in terms of recycling. South Africa has however achieved a recycling rate of 41.8% in 2016, of which more than 95% is post-consumer. Plastics SA has set an ideal of no plastics to landfills by 2030, and plans are being set in place to achieve this goal. Inadequate waste disposal infrastructure and protocols, especially in informal settlements causes large quantities of unrecycled plastic to end up in domestic water, sewage treatment water and river systems. Many South Africans believe that the country’s ‘plastic footprint’, but efforts in terms of microplastics are trailing. We collected and filtered 46 fresh water samples from various localities in and around Gauteng, the most densely populated province in South Africa. High levels of plastic pollution were found in almost all samples. Up to 40 plastic particles (> 20 µm) per litre were found in surface water of the Vaal River, a major river in the country’s largest drainage basin flow through industrialized areas. These levels are comparable to high levels of microplastic pollution found in European rivers. The growing plastics industry in South Africa requires excellence in clean-up and recycling to reduce the negative impacts on the environment and create a viable plastic sector.

Understanding the distribution and fate of microplastics in a tertiary sewage treatment plant in the UK

R.M. Blair, S. Waldron, University of Glasgow; C. Gauchotte-Lindsay, University of Glasgow / Infrastructure and Environment; V. Phoenix, University of Strathclyde / Civil and Environmental Engineering.

Microplastics (MPs; < 0.5 mm) are classified as contaminants of emerging concern but currently are not regulated by water quality standards. Microplastics are highly diverse and their distribution in the environment is highly variable in space and time, making their quantification and risk assessment difficult. Further, their monitoring and regulation are hindered by limited empirical data, particularly of fresh- and wastewater systems as important pathways of land-based contaminants to oceans. Here, a study was conducted in a tertiary sewage treatment plant in the UK (Glasgow, Scotland) to assess the presence of MPs in the system and the effect of treatment stage in removing these contaminants before discharge into recipient waters. The MPs were extracted from 5 litre water samples at each treatment stage, using H2O2 digestion and vacuum filtration through 1.2 µm GF filter. Characterisation and quantification of MPs was carried out by light microscopy followed by detailed chemical analysis of representative subsamples via SEM-EDS and FTIR-ATR. Microplastics were present in wastewater samples collected at all treatment stages, and abundances generally decreased from inflow to outflow. Further, high variability of contaminant abundances was evident across sampling dates. Chemical characterisation by SEM-EDS revealed that 94% of analysed pieces were C-based materials, but only 25% were confirmed plastics based on FTIR-ATR results. In conclusion, the tertiary treatment process evaluated here efficiently removes MPs entering the system but small quantities may still be discharged into the environment. Further, visual characterisation with light microscopy may result in overestimation of MPs due to misidentification of cellulose and other non-plastic microdebris as plastics. Therefore, analysis of chemical composition through a combination of detailed analytical techniques is crucial for improved accuracy of results. This study contributes to understanding what methods are needed to extract and identify MPs from environmental samples, and the spatio-temporal data generated provide understanding of what needs to be monitored and where controls should be implemented.

Weathering-induced changes in the effects of microplastic particles and their leachates

C. Jakob, Helmholz Centre for Environmental Research - UFZ GmbH / Cell Technology; C.D. Runnel, Helmholtz Centre for Environmental Research GmbH - UFZ / Department of Bioanalytical Ecotoxicology; D. Kühnel, Helmholtz-Centre for Environmental Research / Bioanalytical Ecotoxicology; M. Schmitt-Jansen, UFZ - Helmholtz Crc Environn. Research / Department of Bioanalytical Ecotoxicology; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; M. MacLeod, University of Stockholm / Department of Environmental Science and Analytical Chemistry.

Studies on the potential effects of microplastic (MP) particles in the aquatic environment are numerous. However, many laboratory studies apply spherical, pristine particles, which may be of limited relevance given UV light irradiation, mechanical stress, salinity, biofilm growth and other factors that can influence the weathering of the particles. To evaluate the effects of weathered MP particles, the Oceans-funded project WEATHER-MIC is to assess the impacts that weathering has on the transport, fate and effects of MP particles and their leachates. We summarize recent results on potential effects. (1.) Impact of MP particles on organisms: We have exposed copepods, daphnia and algae to different fractions of virgin and weathered MP as well as particle-free leachates under controlled conditions. From the observation of apical endpoints in the acute toxicity assays, concentration-response relationships for the different fractions can be deduced. A critical evaluation of the suitability of the applied test protocols for the assessment of adverse effects of MP will be presented. (2.) Influence of ageing plastic and leachates on biofilm structure and function: Natural biofilms (containing bacteria, algae and fungi, embedded in extracellular polymeric substances) grown on microcosms on different types of aged and pristine polymeric substrates have been studied to observe the influence of weathering on the attachment and succession of biofilms. Sum parameters (biomass, pigment profiles, photosynthesis) and sequencing data were studied. (3.) Mixture effects of leachates from the most common polymers: Cell-based biosassays have been applied to study mixture effects of additives and degradation products of the polymers liberated during weathering of plastic material in artificial seawater in agitated UV chambers. The chemicals in the seawater leachates were enriched by solid-phase extraction or chemicals were directly extracted from pristine particles by ultrasonic-assisted solvent extraction. The concentrated leachates and solvent extracts were then dosed into cell-based biosassays, covering i) cytotoxicity; ii) activation of mitochondrial enzymes, e.g. via binding to neurotoxic carbon receptors; iii) specific, receptor-mediated effects such as estrogenicity; and iv) adaptive stress responses such as oxidative stress. The results may help to understand effects caused by additives and parent compounds opposed to the degradation products liberated from the UV-weathered plastic.
important substances to current economic activities, new materials for MPs will be needed such as cellulose. Though alternative of the materials is mainly conducted in personal care products, effect of the volunteer actions and various regulations on decrease of MPs in aquatic environments has not been evaluated. It is necessary to reveal their sources such as sewage waste, sewage treatment waste, wastes in aquatic environments and so on. This research shows occurrence and characteristics of MPs in sewage waste, sewage treatment waste and river water by coagulation and FT-IR microscopy methods developed in our laboratory. MPs in the various contaminated water were collected by a plankton net whose mesh size is 10 µm. The collected particles were separated by a density separation method. After that, MPs in the collected particles were separated by coagulation process. Finally, the MPs were passed through a membrane and were identified by standard methods. Standardization of MPs by FT-IR microscopy, MPs are characterized by materials, size, color and multi-regression analysis by FT-IR spectrum data. Based on these data, contribution of MPs from personal care products to total MPs concentration will be discussed as well as estimation of sources of MPs in various water samples.

TU160 Detection of micro-paint particles and microplastic in harbour soil samples using FPA-µFTIR-Imaging-FTIR
A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; M. Simon, N. van Alst, F. Liu, Aalborg University / Civil Engineering Department; K.B. Olesen, Aalborg University / Department of Civil Engineering (32%), alloy coating (10%) and polyethylene (17%). The particle size distribution showed the most abundant size ranges were between 20 - 40 µm and 40 - 80 µm. The high MP and MPP concentration measured in the sample highlights the harbor areas are potential hotspots for the accumulation and further spreading of MP and MPP in the terrestrial and aquatic environment. Microplastic and micro-paint particles were successfully extracted and detected in a recreational harbor area using the art analytical approach including multi-step sample preparation and FPA-µFTIR-Imaging analysis, the most suitable spectroscopic technique for an unbiased MP detection and quantification.

TU161 Runoff of microplastics from agricultural soil: a study in a semi-arid area
R. Hurling, NIVA - Norwegian Institute for Water Research; T.C. Schell, IMDEA Water Institute / Ecotoxicology; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences; L. Nizzetto, NIVA
More than 90% of microplastics (MPs) present in raw wastewater are captured by treatment plants and much of that is oxidized to remove organic matter. The analysis was carried out using FPA-µFTIR-Imaging spectroscopy and the data were processed with a dedicated software (MPHunter) developed at Aalborg University. The first results highlighted a high micro-paint and microplastic particles contamination. The total MP and MPP concentration measured in the sample highlights the harbor areas are potential hotspots for the accumulation and further spreading of MP and MPP in the terrestrial and aquatic environment. Microplastic and micro-paint particles were successfully extracted and detected in a recreational harbor area using the art analytical approach including multi-step sample preparation and FPA-µFTIR-Imaging analysis, the most suitable spectroscopic technique for an unbiased MP detection and quantification.

TU162 Microplastics in wastewater and freshwaters: a case-study in the Henares river watershed (Central Spain)
T.C. Schell, IMDEA Water Institute / Ecotoxicology; R. Hurley, Norwegian Institute for water research; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences
Wastewater is considered to be one of the major sources of microplastics (MPs) entering surface waters. Although a high retention potential of wastewater treatment plants (WWTPs) for MPs in raw wastewater has been reported, the composition and transfer processes were not determined. The objective of this study was to determine the vertical MP transfer within the soil, using agricultural soils and to ascertain the MP contribution of WWTP effluents. The study was carried out in the Henares River watershed (Central Spain). Five WWTPs with differing dimensions (population equivalents between 10,000 and approx. 400,000) delivering influent types (domestic, industrial, or both mixed), and differing treatment processes were selected. Wastewater influent, outflow, and sludge (humid and dried) samples from WWTPs were collected during two different seasons (spring and autumn). In addition, river water and sediment samples were taken in three different seasons (spring, summer, and autumn) at three differently impacted sites: (i) low human impact; (ii) high agricultural impact; and (iii) high mixed impact (urban, agricultural, industrial). MPs in river water and wastewater were divided into four fractions by filtering a suitable amount of water through plankton nets of different mesh sizes (from 300 to 20 mm). In order to assess the MP concentration and composition in the samples, solid substrates (sludge and river sediment) were subjected to an organic matter removal treatment, followed by density extraction. Subsequently, those samples, as well as the liquid samples (river and wastewater), were filtered onto filter papers to visually identify the MP content and then chemically characterize their polymer composition using FTIR spectroscopy. Finally, the more evident characteristics of the watershed (total population, characteristics and location of WWTPs, agricultural land use patterns including sludge application, etc.) will be integrated into the study’s findings to deduce their importance for MP contamination. The preliminary results of the distribution and characterization of MP in different matrices are presented.

TU163 Microplastics occurrence and composition in drinking water from a Norwegian urban area
a. gomiero, International Research Institute of Stavanger / Environment; G. Skogerbø, IVAR; K. Øysæd, A. Vatland Krøvel, International Research Institute of Stavanger
Microplastics as a potential health and environmental problem has gained increasing attention recently. Microplastic is defined as plastic pieces smaller than 5 mm in diameter, and the sources of microplastic are many. State of the art literature reports that microplastics are ubiquitous worldwide. While several authors report fragmentation of plastic particles in different environments, little is known about the particle sizes and morphological compartments of marine, freshwater and terrestrial ecosystems; others point out the accumulation of micro- and nanometric sized plastic particles thorough the marine and terrestrial food webs posing the risk of marine and terrestrial life and ultimately the human health. Despite of these studies point out the occurrence of micro plastics in freshwater systems including surface and groundwater basins, very little in know about their occurrence in drinking water. The Institute of Stavanger and their implications on human health. According to the WHO men should consume 3 L and women should consume 2.2 L of beverage per day. Most of these beverages consist of tap water, or drinks derived from tap water (such as coffee, tea, or reconstituted juice). The risk of plastic uptake from drinking water is currently unpredictable and furthermore, these plastic particles are in addition to plastics potentially consumed in the diet, such as salt, sugar, and food and seafood. The research tasks of the present work were: Map published and available literature, develop and optimize a standardized fast, sensitive protocol for sampling and quantification of nano/microplastics particles in drinking water and finally. Analyze and possibly
detect microplastic particles in drinking water supply systems with special focus on different polymeric composition and size fractions. Study area was the Rogaland area (Norway) populated by approx 110,000 inhabitants. Samples of drinking water were collected every two week for ten months contemporary from the supply water system collection point as well as in different sites of the urban area. A fast and sensitive method based on a GCMS-pyrolysis was developed. Polyethylene, Polypropylene and Polyvinyl chloride were the most recurrent polymers. Levels ranged from 0.02 to 16 ng/L. Time and space related trend are presented.

Macro and Micro(plastics) in the Environment of Some French rivers

S. Turner, University College London / Geography; A.A. Horton, Centre for Ecology and Hydrology; N. Rose, University College London / Department of Geography

A historical record of microplastics extracted from a radionuclide (137Pb and 137Cs) dated sediment core from a London lake provides novel data on the long-term accumulation rates are indicative of plastic usage in the dated sediment core from a London lake provides novel data on the long.

Historical record of microplastics extracted from the sediments, especially at the entrance of the Allier River, and linking it to the density of the vegetal areas. 2. Set up on site a controlled pollution to follow its fate along the time 3. Analyze the composition of microplastics extracted from the sediments, especially at the entrance of the abandoned channel, where it may exist some vortices of flow. These first three points are the topic of the Plasticscages project supported by the CNRS[1, 2]. 4. Collect and analyze the composition of microplastics in the surface waters of different French rivers (Allier, Charente, Loire, Touvre, etc.). To do this, we rely on citizen science operations, in particular thanks to the contribution of the babybag sampling net [3,4], which makes it possible to multiply samples and analyzes. 1 Occurrence of plastic litters in the Allier river in France. Vincent Verney, Gaëlle Bissagou Koumba, Alexandre Garreau, Florence Delor, Erwan Roussin, Olivier Voldoire, Jean-Luc Peiry; To be published

Microplastics from sewage treatment works and storm water outfalls... discharge into the Victoria Harbour, Hong Kong SAR. We conducted surveys of microplastic pollution in the surface waters and sediments from Deep Bay, Tolo Harbour, Tsing Yi, and Victoria Harbour in HKSAR. In the microplastics survey (June 2015 to March 2017), the averaged concentrations of microplastics in local coastal waters and sediments respectively ranged from 51 to 27,000 particles per m3 and 49.0 to 68,000 particles per m2. The highest concentration of micro-plastics (coastal water) was recorded as 35,642 particles per m3 in March 2016 in Victoria Harbour (West Kowloon). Therefore, we also study the effluents directly discharged from chemical enhanced primary sewage treatment works (Stonecutters Island STW) and secondary sewage treatment works (Sha Tin STW), and two stormwater outfalls (SOWs) (Kwun Tong Ferry Pier, New York Avenue, Kowloon) using a sensitive method based on a GC/MS-Selected ion monitoring. We monitored polyethylene, polypropylene, polystyrene, polyvinyl chloride, and polyamide, and identified 3,600 different microplastic waste into the environment and should be included in future analyses to enable calculation of catchment-based budgets of microplastic contamination.

Models for Data Synthesis, Sampling Design and Scenario Analysis: Some Models using the INCA-MP model of microplastic fate and transport in soils and surface waters

M. Futter, Swedish University of Agricultural Science / Aquatic Sciences and Assessment; J. Crossman, University of Windsor; J. Ledesma, V. Russo, E. Lannergård, SLU Swedish University of Agricultural Sciences / Aquatic Sciences and Assessment; L. Nizzetto, NIVA

Quantification and classification of microplastics in soils, sludge and surface waters is both time consuming and expensive. Ideally, measurement campaigns can be focussed on areas that are likely to provide the greatest returns on effort yet this is often difficult to accomplish. Here, we show how the Inland Integrated Catchments model for Micro Plastics, the first published model of microplastic terrestrial fate, riverine transport and contaminant co-transport can be used to synthesize available data, identify knowledge gaps, plan monitoring, and perform risk assessments. Synthesizing available data involves collation of microplastic and proxy data. We show how proxy information, including timing and size, can be used to refine models of both terrestrial and aquatic transport. In addition, high frequency water quality monitoring can constrain estimates of microplastic mobility in terrestrial and freshwater environments. Through the application of uncertainty analysis in INCA-MP, it is possible to identify the most sensitive pools and processes when making predictions of microplastic fate and transport. Furthermore, knowledge gaps related to these pools and processes can then be targeted for more intensive future sampling campaigns. As an INCA-MP includes sophisticated routines for tracking the environmental fate of current and emerging micropllubutant the model can be used for risk assessment of co-transported contaminants. Such information is needed both for more targeted sampling techniques applied to environmental and biological samples. Biological samples (fishes and mussels) were also collected in two SOW for the assessment of microplastics abundance and composition in its digestive system. Microplastics of different shapes from sewage and biota (mainly fragments, lines, fibres, and pellets) were identified by means of Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy. Zebrafish exposed to microplastics individually would ingest different sizes of polyethylene microbeads (10-22µm, 45 to 54µm, 90-106µm, 212-250µm & 500-600µm) and their digestive tracts and gill filaments were fully occupied by microbeads. Mixtures of microbeads in environmental related concentrations are used for expression profile of cytochrome P450 1A1 (CYP1A1) and 27,000 particles per m3 and 49.0 to 68,000 particles per m2. The highest concentration of micro-plastics (coastal water) was recorded as 35,642 particles per m3 in March 2016 in Victoria Harbour (West Kowloon). Therefore, we also study the effluents directly discharged from chemical enhanced primary sewage treatment works (Stonecutters Island STW) and secondary sewage treatment works (Sha Tin STW), and two stormwater outfalls (SOWs) (Kwun Tong Ferry Pier, New York Avenue, Kowloon) using a sensitive method based on a GC/MS-Selected ion monitoring. We monitored polyethylene, polypropylene, polystyrene, polyvinyl chloride, and polyamide, and identified 3,600 different microplastic waste into the environment and should be included in future analyses to enable calculation of catchment-based budgets of microplastic contamination.

Detection of microplastic waste into the environment and should be included in future analyses to enable calculation of catchment-based budgets of microplastic contamination.
plastics in the environment have been detected. Packaging, pellets and parts of a kitchen sponge were found in the stomachs of seabirds; Whales and seals were caught in polypropylene cords. By weathering and fragmenting larger plastic objects (macroplastics) into smaller pieces (microplastics), plastic waste in the environment seems to be gradually disappearing. However, as recent research shows, microplastic is found in freshwater, on beaches and in open water, in the deep sea and in the Antarctic ice. It is taken up by organisms and passes on in the food chain. The long dismantling periods suggest that plastic waste will accompany, if not outlast, mankind for a long time to come. Although the number of publications on microplastics has risen in the last two decades and the topic has entered the social discourse, there are still many research gaps on sources, pathways, amounts, sinks, accumulation spaces, adsorption and absorption of pollutants as well as damaging effects on organisms and humans. The project PlasticBudget is aiming to close some of the above-mentioned research gaps. Taking into account the relevance that plastic litter has gained in recent years in the environmental discussion, the assessment of the environmental impact of those emissions is needed. Macro- or microplastics’ emissions have an impact on ecotoxicity (for example, when birds or fish confuse plastic with food) and human toxicity (for example by eating food, which contains microplastics). The resulting environmental impacts could be, for example, the extensively documented dying of marine organisms by microplastics, the danger of massive aggregation of tiny plastic particles in the food chain, or even the negative aesthetic impact associated with plastic in the environment. Corresponding midpoint and endpoint indicators and associated characterization methods, as well as standardization to a reference value (e.g. the production volume of the specific plastic), are therefore developed in the PlastikBudget-project and discussed in expert dialogues as well as workshops.

TU172 How do we know that microplastics are different from natural particles in their effects on biota?
Z. Gerdes, M. Ogonowski, E. Gorokhova, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES) Microplastics (MP) have been identified as a potential environmental hazard, which has motivated a wide range of effect-studies, testing different combinations of polymers, sizes and shapes. However, risk assessment of MP exposure, in the lower size range < 100µm, is today hampered by both the lack of data regarding their presence in the environment and the inadequate experimental design of many effect-studies. A crucial issue in designing such studies is to include control particles that are ubiquitously present in the environment and represent a background variability with regard to suspended solids. Such controls, allow effects caused by the particle itself to be separated from the effects of the test substance. This separation is crucial for testing MP-specific effects, as many test organisms are suspension-feeders that have evolved in turbid aquatic environments. To highlight and provide examples of the importance of particle controls in MP-effect studies we will present: I) results of a review on effects of particle suspensions (MP, or natural nutritionally inert particles), and II) case studies employing control particles. The data will strongly suggest that particle controls are essential for identification of MP-specific effects, so that MP impacts can be assessed based on ecological soundness.

TU173 Influence of environmental conditions on the sorption of organic pollutants to microplastics
S. Seidensticker, J. Lamprecht, P. Grathwohl, Eberhard Karls Universität Tübingen / Center for Applied Geoscience; C. Zarfl, University of Tuebingen / Center for Applied Geoscience The ubiquitous contamination of all environmental compartments with microplastics has been extensively discussed in both science and public. Large numbers of microplastics have been measured in effluents of wastewater treatment plants. These particles might act as sorbent and transporter for frequently occurring wastewater contaminants and are hence a factor that needs to be considered if the environmental fate of pollutants is examined. Some contaminants, among those also microplastics like pharmaceuticals, can be charged under certain pH conditions. While it is known for a wide variety of natural particles that charged compounds sorb only little or not at all, sorption interactions between microplastics and charged compounds have not been analysed so far. Thus, the aim of this study was to clarify the sorption behaviour of dissociating compounds to microplastic particles. We measured the equilibrium partitioning between 19 typical wastewater contaminants (pharmaceuticals, personal care products, pesticides) and microplastics at three pH values (4, 7, 10). The investigated compounds showed a wide variety in their physico-chemical properties, e.g. a log K_D range between 0.1 and 5.8 and pK_a-values from 1.6 to 13.9. We performed batch experiments with fourteen ionizable and five non-ionizable substances. In all experiments equilibrium was reached after two days. Measured log K_D for the neutral species ranged from 0.75 to 4.00. The uptake of contaminants varied according to their hydrophobicity. Sorption of ionizable substances is strongly influenced by the pH while non-ionizable substances showed a partitioning independent of pH. For sorption into polyethylene, the amount of accumulated pollutants is principally dominated by the neutral fraction, while the charged

campaigns and for communicating risks associated with microplastics in terrestrial and freshwater environments. We illustrate these concepts using data from Swedish and Canadian catchments. Our results show the importance of autumn storms and spring snowmelt for microplastic mobilisation to surface waters and highlight the potential knowledge gains associated with targeted sampling of riverine sediments, constructed wetlands and waste treatment facilities.

TU169 Occurrence and concentration of microplastics in an urban river
C. Campanale, C. Massarelli, G. Bagnuolo, Italian National Research Council; V. Uricchio, Italian National Research Council / Water Research Institute The term ‘microplastics’ was first used in 2004 to describe very small fragments of plastics < 50 µm in the water column and in sediments. In Table 2, a pH of 7.0 and 95% of the marine litter, including microplastics, come from land environment, studies of microplastics in freshwater systems are limited respectively to those focused on marine habitats. Rivers and inland waters may transport microplastics to marine habitats and may be a novel vector for the downstream transport of organic persistent pollutants suggesting an overlooked and potentially significant component of the global microplastic life cycle. Herein we report results from a monitoring study with the main objective of evaluate the occurrence and concentration of microplastics in an italian urban river and assess the hypotheses that microplastics amount could vary in response to temporal and seasonal studies. The efficiency of a disc filter to remove microplastic particles from the river water was determined as 96% by using pyrolysis-gas chromatography-mass spectrometry (Pyrolysis GC-MS). The composition of microplastic was studied in terms of size, shape, color and polymer type. Results from the six replicates are expressed as mean values (± DEV. ST.) of number of particles per cubic meter (p/m³). Microplastics were found in each net sample for a total amount of 22152 items collected, photographed, enumerated and categorized. Sample concentrations ranged from 3.52 to 13.43 p/m³ showing significantly higher abundances during February than April campaign (Mann–Whitney U Test = 18.00; p-value = 0.028). A total of five polymer have been characterized: PE, PP, PS, PVC and TDI-PUR. All samples contained at least three polymer types: PE, PP and PS. PE accounted for 77% of the total particles identified, followed by PS (12%), PP (10%), PVC (0.9%) and PU (0.4%).

TU170 Removal of 10-500 µm microplastics from wastewater effluent by disc filter
M. Simon, Aalborg University; N. van Alst, Aalborg University / Civil Engineering Department; K.B. Olesen, Aalborg University / Department of Civil Engineering; F. Liu, J. Vollertsen, Aalborg University / Civil Engineering Department In this study the efficiency of a disc filter to remove microplastic concentrations from wastewater effluent was evaluated. The size range of particles addressed was 10-500 µm and the identification technology was micro-FTIR imaging spectroscopy applying a focal plane array (FPA). Effluent wastewater was collected at the wastewater treatment facility at Grinsted, Denmark operated by Billund Spildevand A/S. The treated wastewater was sampled before and after the disc filter by using a 1000 L stainless steel large-scale water sampling device. The filtered volume of effluent wastewater before the filter was 200 L and 1.6 m³ after the filter. The residue collected on the filters containing a mixture of organic matter, inorganic particles and microplastics was subjected to a purification procedure including enzymatic digestion, chemical oxidation and filtration in order to eliminate the sample matrix and extract the microplastics. Non-degradable particles were stored in ethanol, and a fraction of the ethanol particle suspension transferred to a transmission window to quantify particles by infrared imaging technique. The entire window was scanned to create a mosaic with 3.3 µm pixel resolution on the FPA. The spectra of all particles in a scan were analyzed to quantify their chemical composition and to determine whether they were of plastic, and if so, of which plastic material. The optical analysis was conducted with a semi-automated IR spectra analyzer software developed at Aalborg University, Denmark. The size and shape of plastic particles were recorded and their mass was estimated. Preliminary data shows that the removal efficiency of the disc filter was 96 % in terms of both mass and particle number. The material composition of plastic in the sample before the filter (polystyrene, polyethylene and acrylates) was somewhat dissimilar to the composition in the effluent sampled after the filter (polystyrene and polystyrene).

TU171 PlasticBudget - Project on the environmental assessment of microplastic emissions
N. Thonemann, Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT Shortly after the introduction of many types of plastics (e.g. polystyrene, polyethylene terephthalate, polypropylene) in the 30s, 40s and 50s, first traces of...
species did not contribute. Thus, with increasing pH sorption of acids decreased while the sorption of bases increased. Whereas electrostatic interactions between charged species and polyethylene could not be detected, this might be different for other polymers, such as polyethylene and polyamide.

**TU174 Influence of microplastics on transport of organic contaminants in soil**

T. Huffer, S. Slawek, T. Hofmann, University of Vienna / Department of Environmental Geosciences

The worldwide production and usage of mainly disposable plastic has increased from 1.7 million tons in 1950 to 299 million tons in 2013 [1]. Consequently, plastic wastes are deposited in the environment and persist due to long durability and limited recovery [2]. Polyethylene is one of the mass-manufactured polymers that is found in the terrestrial environment, used in many different sectors, including agricultural mulches, composts and packaging material [3]. To date, microplastics have been mainly studied in marine and freshwater systems, whereas there is hardly any data on microplastic occurrence, fate, and effect in terrestrial environments [2]. Low-density polyethylene (LDPE) foils, that may become brittle due to insolation, are used in large amounts on agricultural areas to protect crops, suppress weeds, regulate the temperature and retain irrigation water in the soils [1]. In soil microplastics may affect the transport of hydrophobic organic pollutants and pesticides, as they can be preferentially sorbed by polymer particles with large surface to volume ratio compared to sorption by natural sorbents [1, 4]. The strength of sorption as well as the relevant molecular interactions depend on the polymer type, because they can interact [5]. To investigate this, we studied the transport of organic contaminants in a soil under varying aqueous conditions. [1] K. Duys, A. Coors, Environ. Sci. Eur. 2016, 28, 2. [2] M. Rillig, Environ. Sci. Technol. 2012, 46, 6453. [3] M. Beg, S. Kornin, M. Bijarimi, H. Zaman, Adv. Polymer Technol. 2015, 35, 2152. [4] A. Bakir, S. Rawland, R. Thomson, Mar. Pollut. Bull. 2012, 64, 7828. [5] T. Huffer, T. Hofmann, Environ. Pollut. 2016, 214, 194.

**TU175 Influence of polystyrene microplastics in combination with organic pesticides on the giant rams-horn snail Marisa cornuarietis: behavioral and biochemical responses**

S. Krais, University of Tubingen / Animal Physiiological Ecology; H. Schmiegel, Tubingen University / Animal Physiological Ecology; E.E. May, University of Tubingen / Animal Physiological Ecology; A.S. Ruhl, TU Berlin / Department of Water Quality Control; H. Köhler, University of Tubingen / Animal Physiological Ecology; R. Triebkorn, University of Tubingen / Animal Physiological Ecology

Due to the increasing demand for and usage of plastic products during the last 50 years, the presence of microplastics in the environment is estimated to be on the order of hundreds to thousands of years, being particularly relevant for microplastic changes in the marine environment including 17α-ethynylestradiol and detergents. The effect that competitive binding of biomolecules naturally secreted by Daphnia have on both adsorption and desorption (Hsp70 level) and neurotoxicity (inhibition of acetylcholinesterase). The analyses, however, are still in progress. The study is part of the joint research project MiWa ('microplastics in the water cycle') funded by the German Federal Ministry of Education and Research (support code: 02WV1824).
Analytical Chemistry (ACES). Conventional, oil-based polymers are considered as the major source of microplastic pollution, whereas biodegradable polymers (bioplastics) have not attracted much attention as sources of microplastics. However, given that production of bioplastics is increasing and that biodegradation is slow under ambient conditions, it is likely that they enter the aquatic environment in the same way as oil-based polymers. Therefore, it is important to understand potential environmental impacts of both polymer types. We compared effects of exposure to polystylic acid (PLA; bioplastic) and polystyrene (PS; oil-based polymer) on primary life history traits in the crustacean Daphnia magna, a standard model species in ecotoxicology. To exclude particle effects caused by food dilution and thus identify microplastic-specific effects, kaolin clay was used as a reference treatment. In total, four treatments were included: PLA, PS, clay (reference), and control (food only). The exposure was conducted over 21 d using a plankton wheel to keep test particles and algae in suspension for comparable exposure concentrations. In the PS treatment, we observed high mortality, decreased feeding rate and reproductive output compared to all other treatments. These effects were not caused by toxic monomers of styrene or additives leaching out of the polymer, which was demonstrated in a follow-up test with the PS leachate. By contrast, no significant effects were found in the daphnids exposed to PLA compared to the reference treatment. Thus, a significantly higher toxicity of the conventional polymer was observed, whereas effects of the biodegradable microplastics were similar to those caused by the ubiquitously occurring clay particles. More studies are needed to identify the mechanisms of PS toxicity and to confirm the observed ecotoxicological differences between the polymer types using different test species. To evaluate toxicity of these materials, it is essential to include a reference treatment as a benchmark.

TU179
Effects of polystyrene microplastics in different life stages of brown trout (Salmo trutta f. fario)
H. Schmieg, Tübingen University / Animal Physiological Ecology; S. Krais, University of Tubingen / Animal Physiological Ecology; F. Rezbach, University of Tubingen / Animal Physiological Ecology; A.S. Ruhl, TU Berlin / Department of Water Quality Control; H. Köhler, University of Tubingen / Animal Physiological Ecology; R. Truesbrom, University of Tubingen / Animal Physiological Ecology
The widespread use of plastic products in our daily life has led to a constant increase in the production of synthetic polymers. In consequence and also resulting from the longevity of plastics, high amounts of plastic debris can be found worldwide in aquatic and terrestrial environments. In general, plastic items smaller than 5 millimeters are defined as microplastics. Primary microplastics are produced for different purposes and are, for example, contained in many cosmetic products. Abrasion and fragmentation of larger plastic items lead to the formation of secondary microplastics. Up to now, most studies investigating effects of microplastics in organisms concentrate on marine ecosystems, whereas knowledge on effects of microplastics in freshwater organisms is still scarce. The aim of our study is to investigate effects of polystyrene microplastics (cryogenically milled granules, fractionated to < 50 µm, up to 100.000 particles/L), also in combination with organic pollutants (pharmaceutical, pesticide), in different life stages of brown trout (Salmo trutta f. fario). For that purpose, we conducted a fish early life stage test (FELST) according to OECD 212. The endpoints of interest were heart rate, hatching success and mortality. After consumption of the yolk sac by the fish larvae, we additionally investigated the level of oxidative stress by means of the ferricytochrome c assay (FCC assay). In addition, we examined effects of polystyrene particles (< 50 µm, 10,000 particles/L) alone and in combination with the pesticide methiocarb in juvenile (11 months old) brown trout. In this experiment, the mortality rate, biometric parameters, the level of oxidative stress, the induction of the 70 kD stress protein (Hsp70) and the inhibition of acetylcholinesterase were under investigation. Furthermore, we examined histopathological effects in gills and in guts of the trout. First results showed no effect of microplastics on mortality and biometric values of either larval or juvenile brown trout. Further analyses are still in progress. The present study is part of the joint research project “MiWa” (microplastics in freshwater systems) funded by the German Federal Ministry of Education and Research (support code: 02WR1S378).

TU180
Daphnids in distress? Acute and chronic effects of primary and secondary microplastics on three species of Cladocerans
G. Jakumar, CML Leiden University / CML; N. Brum, CML Leiden University / Conservation Biology; J. Baas, Centre for Ecology & Hydrology / Centre for Ecology & Hydrology; J. de Ruijter, CML Leiden University / Microbiology; T. Bosker, CML Leiden University / Ceter for Environmental Sciences Microplastics (< 5mm) are ubiquitously distributed in the environment, causing increasing concern in recent years. The two predominant types of microplastic differ in shape and origin: primary microplastics (PMP) are intentionally produced as micro-particles for commercial applications, whereas secondary microplastics (SMP) are formed by the environmental breakdown of large plastics. Information regarding effects of microplastics on freshwater ecosystems is limited. In the present study, the acute and chronic effects of microplastics on three Cladocerans species, Daphnia magna, Daphnia pulex, and Ceriodaphnia dubia, to both PMP and SMP was assessed. The acute toxicity was assessed at 180, 220, and 260 C, to determine the influence of temperature as an additional stressor on toxicity. Acute sensitivity of D. magna and D. pulex to both PMP and SMP, increased sharply with temperature, whereas that of C. dubia was stable across temperatures. C. dubia was the most sensitive species at 180, followed by D. pulex and D. magna, which were of comparable sensitivity, however, the trend was reversed at 260 C. In addition, SMP showed a similar increase in toxicity to C. dubia. Both PMP and SMP showed adverse effects on all three species during chronic exposure. Further, C. dubia was the most sensitive species followed by D. pulex and D. magna. All species were more affected by PMP than SMP during chronic exposure. The results of the current study indicate that exposure to microplastics has adverse effects on health and reproductive output of the species studied, although at relatively high levels of exposure, and that temperature as an environmentally relevant additional stressor has a major influence on species sensitivity to microplastics.

TU181
Evaluation of chronic toxicity of polystyrene microplastics on freshwater mussels
S. Magni, University of Milan / Department of Biosciences; F. Gagne, Environment and Climate Change Canada; C. Della Torre, State University of Milano / Biosciences; C. André, J. Auclair, H. Hanana, Environment and Climate Change Canada / Aquatic Contaminants Research Division; F. Bonasoro, University of Milan / Department of Environmental Science and Policy; A. Binelli, University of Milano / Department of Environmental Science and Policy
The annual global plastic production follows a positive trend and plastic pollution represents an emerging worldwide issue. In particular, microplastics (MPs), plastic fragment smaller than 5 mm, are potentially dangerous for aquatic community because their ability to be accumulating in the tissues of biota. MPs can reach the aquatic environment through the Wastewater Treatment Plants (WWTPs) or atmospheres, delivering the degradation or modification of the polymers. Considering that few studies, especially in freshwater environment, have been conducted about the adverse effects of MPs, the aim of our study is the evaluation of chronic toxicity of these contaminants on the freshwater mussel Dreissena polymorpha using a multi-biomarker approach. As MP standards we choose two different beads of polystyrene, one of the most common MP classes detected in the environment, with a size of 1 and 10 µm. On the basis of the daily great release of MPs from WWTPs, we tested the following mixtures (MIXs) of polystyrene MPs: MIX1, which contained 2 million/L of 10 µm MPs and 2 million/L of 1 µm MPs, and MIX2, which contained 500,000/L of 10 µm MP and 500,000/L of 1 µm MPs. Therefore, mussels were exposed for 7 days in static conditions to the MIXs and to related controls. Every 3 days we collected from each tank the mussels to assess both chronic toxicity and uptake of polystyrene MPs. We evaluated the adverse effects by monitoring end-points of cellular stress, as the activity of antioxidant and detoxifying enzymes, oxidative damage, cyto-genotoxicity and neurotoxicity (analyses in progress). To evaluate the uptake of polystyrene MPs in the exposed mussels, exploiting the reflection of MPs, we collected hemolymph and then fixed it with the soft tissue of cryostat sectioning. We then observed the samples using the confocal microscopy. Despite we found both sizes of polystyrene MPs in the hemolymph and soft tissues of mussels, we did not obtain significant increase of tested biomarkers compared to controls, excepted for a significant increase of CAT activity at the end of exposure for mussels exposed to MIX 2. The lack of adverse effects induced by tested MPs could suggest that the toxicity of MPs could be related to the exposure time, thus modifying chemicals, or involved in metabolic pathways not detectable by our biomarkers. In addition, prolonging the exposure time the MP toxicity could be increased.

TU182
Polystyrene microplastic effects on the lipid peroxidation and antioxidant capacity in non- and temperature-stressed individuals of Dreissena polymorpha
A. Weber, N. Jeckel, C. Weil, S. Umbach, Goethe University Frankfurt am Main / Aquatic Ecotoxicology; N. Brennholt, German Federal Institute of Hydrology / Biochemistry and Ecotoxicology; G. Reifferscheid, German Federal Institute of Hydrology; M. Wagner, Norwegian University of Science and Technology / Department of Biology
Microplastic (MP) toxicity has been considered in numerous taxa including bivalves, which are of special interest due to their high filtration activity and therefore MP particle uptake. Previous studies in marine bivalves reported stress and inflammation processes in response to high levels of MP exposure, while data on freshwater species is missing. Therefore, we tested the adverse effects of irregular polystyrene MP (< 63 µm) on the lipid peroxidation and antioxidant capacity in the freshwater bivalve Dreissena polymorpha both in a single and multiple stressor exposure regime. We exposed D. polymorpha to polystyrene MP at concentrations between 6.4 and 100,000 µ M L−1 over 6 weeks at 16 °C. After the exposure, the mussels were analyzed for malondialdehyde concentrations as an indicator for lipid peroxidation (TBARS assay, thiobarbituric acid reactive substances) as well as for the remaining abundance of hydrophilic, non-enzymatic antioxidant substances (ORAC assay, oxygen radical absorbance capacity) – an estimate of the remaining antioxidant capacity. The analysis of lipid peroxidation
and antioxidant capacity did not indicate any increased stress levels in response to chronic MP exposure in *D. polymorpha*. In addition, the same experiment performed in a sub-chronic exposure (1, 3, and 7 d) did not reveal stress-induced effects either. Therefore, this study indicates that polystyrene MP does not induce a stress response in *D. polymorpha* in the current exposure scenario. In a more environmentally realistic scenario, bivalves will experience other stressors (e.g. increased water temperature) besides particulate matter. Thus, we hypothesize that a sub-chronic stress response can be modulated by MP exposure. To explore such a scenario further, we will present results from ongoing multiple-stressor experiments in which we expose *D. polymorpha* to MP at 16, 24 and 28 °C.

**TU183**

**Tissue Translocation of Polystyrene Micro- and Nanoparticles in Daphnia magna**

C. Schueg, Goethe University Frankfurt / Dpt. Aquatic Ecotoxicology; S. Rist, DTU (Technical University of Denmark) / Department of Environmental Engineering; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; M. Wagenius, Norwegian University of Science and Technology / Department of Biology

The last decade has seen a surge in research investigating various aspects of micro- and nanoplastics originating from plastic pollution in aquatic ecosystems. Aspects include occurrence, uptake, and potential effects in biota. Working with particles in a laboratory setting bears its own kinds of challenges, some of which had already been covered by researchers in the realm of nanomaterials. One of our challenges is that biota-particle-interactions is still limited and often based on early studies that – due to the infancy of the field – may have deficiencies in the experimental design and quality controls. One such example relates to the potential of plastic particles to cross the gut epithelium and translocate to other tissues. This phenomenon has been reported in the literature for the freshwater cladoceran *Daphnia magna* and – if true – could be a pathway for polystyrene MP. To substantiate the limited available data, the aim of our study was to replicate these findings. We exposed neonate daphnids in a number of scenarios regarding particle concentration and exposure duration at two independent geographical locations using animals from two separate cultures. We expanded on the previous experiment by improving imaging through the addition of a confocal-based clearing followed by investigation through confocal laser-scans microscopy. We additionally applied the lipophilic dye nile red to localize lipid droplets. This step facilitated the identification of lipid droplets inside the tissue and could therefore associate fluorescence detected before staining to a respective tissue. Our findings potentially challenge previous publications that reported the translocation of both micro- and nanoparticles. This discrepancy may be based on false-negative results on our side or false-positive results in the earlier reports, both potentially caused by inadequate exposure settings during the investigative parts of the studies. We were unable to replicate these findings implying a tissue translocation of nano- and microparticles under conditions closely resembling those reported in the literature. This highlights that the replication of nano- and microparticles studies is important, especially if these have a high impact on the body burden of organisms and interactions with other biota.

**TU184**

**Do terrestrial organisms, isopods Porcellio scaber and earthworms Eisenia andrei, avoid microplastic contaminated soil?**

A. Jemec-Kokalj, University of Ljubljana, Biotechnical Fac. / Department of Biology; P. Židar, University of Ljubljana / Department of Biology Biotechnical Faculty; G. Kalcikova, University of Ljubljana / Faculty of Chemistry and Chemical Technology

Microplastics (MP) can potentially enter the terrestrial environment via sewage sludge deposition on agricultural land. In some countries plastic bags are used as soil cover in home gardens and agricultural land to act as mulch film. Due to fragmentation of these plastic bags, secondary MP may enter the soil and can be further transported along the soil column by bioturbation. Despite the potential presence of MP in the terrestrial environment, data regarding the effect of MP on terrestrial organisms are very scarce. In this study, we investigated if terrestrial isopods *Porcellio scaber* and earthworms *Eisenia andrei* avoid soil contaminated with microplastic. We tested microplastic extracted from facial scrub and fragmented from plastic bag. The mean size of MP from facial cleaner was 0.137 ± 0.051 mm, while the plastic bag MP was larger 8.80 ± 0.55 mm (with 62% of particles smaller than 5 mm). Microplastic was mixed into the soil at environmentally relevant concentration 4 mg/kg dry weight (0.4 % w/w). The isopods were exposed individually and in groups of 10 animals. The test container comprised two identical polypropylene vessels connected with a fixed polypolypropylene tunnel to enable animal migration between the two vessels and covered with a lid. In individual exposure the position of each animal was recorded 10 times within the 48 h exposure period and the number of positions on each side was calculated. In group exposure, the isopods were inspected only after 48 h and the number of animals at each side was recorded. Earthworms were exposed in one test container that was divided when applying the control soil and MP contaminated soil. Before the animals (10) were placed into the test container the divider was removed. The number of animals on each side of the soil was counted after 48 h of exposure. Our results indicate that isopods show no preference or avoidance behaviour towards facial scrub microbeads or plastic bag microplastic contaminated soil. This was shown for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub contaminated soil but were not affected by plastic bag MP. It remains to be investigated how longer exposure to MP would affect the behaviour of terrestrial organisms. Also it is of interest how environmentally aged MP (e.g. coated with biofilm) would affect the organisms. Knowledge in this field is important to assess the potential hazard of microplastic deposited on soil.

**TU185**

**Analysis of the Trojan horse effect of a mixture of microplastics and chlorpyrifos in an aquatic microcosm study**

J. Deerman, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; X. Chen, University College London; T. Strauss, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; H. Hollert, RWTH Aachen University / Institute for Environmental Research

Microplastic particles (MP) are of concern in the aquatic environment because of their increasing amounts in production and release into the environment. Beside their physical adverse effects, MP can sorb hydrophobic chemicals, which can then be transported together into biota by the so called ‘Trojan horse effect’. In this study, a higher CPF could be used as a complex experiment set-up in which CPF was mixed with MP in C. *magna?* and tested with the aim to discover the Trojan horse effect by means of a laboratory aquatic microcosm study. The insecticide chlorpyrifos (CPF) was used sorbed to 5 μm polystyrene microbeads. Beside the control microcosms (C), an MP-control (MPC) group was treated with 4 mg MPl. For two other treatment groups, the same concentration of MP was coated with nominal CPF concentrations of 0.5 μg/L (L) and 5 μg/L (H) in the water phase. H (4 mg MPl) for 14 days, 24 aquaria each. The number of animals at each side was recorded. Earthworms were exposed in one film. Due to **TU186**

**Microplastics exposures of fish: internalization and effects on behavior and growth**

C. vignet, Eawag / UOTO; X. Cousin, IFREMER / Laboratoire de Ressources Halieutiques de La Rochelle; R. Behra, Eawag / Department of Environmental Toxicology; L. Jouassard, IFREMER; L. Sigier, Eawag; M. Bégout, IFREMER / Laboratoire de Ressources Halieutiques de La Rochelle; J. Cachot, Université de Bordeaux / EPOC; K. Schirmer, Eawag / Environmental Toxicology

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Microplastics (MP) can potentially enter the terrestrial environment via sewage sludge deposition on agricultural land. In some countries plastic bags are used as soil cover in home gardens and agricultural land to act as mulch film. Due to fragmentation of these plastic bags, secondary MP may enter the soil and can be further transported along the soil column by bioturbation. Despite the potential presence of MP in the terrestrial environment, our understanding of the effect of MP on terrestrial organisms are very scarce. In this study, we investigated if terrestrial isopods *Porcellio scaber* and earthworms *Eisenia andrei* avoid soil contaminated with microplastic. We tested microplastic extracted from facial scrub and fragmented from plastic bag. The mean size of MP from facial cleaner was 0.137 ± 0.051 mm, while the plastic bag MP was larger 8.80 ± 0.55 mm (with 62% of particles smaller than 5 mm). Microplastic was mixed into the soil at environmentally relevant concentration 4 mg/kg dry weight (0.4 % w/w). The isopods were exposed individually and in groups of 10 animals. The test container comprised two identical polypropylene vessels connected with a fixed polypolypropylene tunnel to enable animal migration between the two vessels and covered with a lid. In individual exposure the position of each animal was recorded 10 times within the 48 h exposure period and the number of positions on each side was calculated. In group exposure, the isopods were inspected only after 48 h and the number of animals at each side was recorded. Earthworms were exposed in one test container that was divided when applying the control soil and MP contaminated soil. Before the animals (10) were placed into the test container the divider was removed. The number of animals on each side of the soil was counted after 48 h of exposure. Our results indicate that isopods show no preference or avoidance behaviour towards facial scrub microbeads or plastic bag microplastic contaminated soil. This was shown for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub contaminated soil but were not affected by plastic bag MP. It remains to be investigated how longer exposure to MP would affect the behaviour of terrestrial organisms. Also it is of interest how environmentally aged MP (e.g. coated with biofilm) would affect the organisms. Knowledge in this field is important to assess the potential hazard of microplastic deposited on soil.
feeding with microparticles contaminated food has consequences on juvenile fish growth. Taken together, our study demonstrates the power and limits of flow cytometry/viSNE for microplastics quantification in a comprehensive biological matrix like fish. The setup could be extended to other types and forms of microplastics in different environmental matrices. Moreover, our study sheds light on ecological consequences that microplastics exposure might have on fish.

TU187 Microplastic ingestion by fish: a comparison of Thames Estuary and Firth of Clyde populations A.R. McGoran, Royal Holloway; P.R. Cowie, Field Studies Council Scotland; P.F. Clark, The Natural History Museum; J.P. McEvoy, D. Morritt, Royal Holloway This study compares the ingestion of microplastic by pelagic and benthic fish populations from two major UK watersheds: the Thames Estuary and the Firth of Clyde. A total of 760 fish from 20 species and 116 brown shrimp, Crangon crangon, were sampled. Individuals were examined under a dissection microscope and potential plastics were removed to be later identified by FTIR analysis. Out of 21 species, including both fish and shrimp, sixteen species from different trophic levels ingested plastics. Overall, 33–47% of fish ingested plastics mostly fibres (85% of potential plastics; before FTIR analysis). In addition, microplastics were also found in the stomach of a common prey species, C. crangon, but had ingested far less plastic than predatory fish species, such as the European flounder, Platichthys flesus. In the Firth of Clyde, benthic, flatfish ingested significantly more plastic than pelagic fish and other benthic fish. This may indicate that, in estuarine systems, plastics accumulate in the sediment.

TU188 Polystyrene microplastic uptake and effects on feeding behaviour and reproduction in the cladooceran Daphnia magna B. de Felve, Università degli Studi di Milano; R. Bacchetta, University of Milan; F. Pettolino, University of Milano / Department of Biomolecular Sciences and Biotechnology; M. Parolini, University of Milan / Department of Environmental Science and Policy Plastic contamination is a well-known environmental problem as demonstrated by the huge presence of plastic debris ranging different sizes in diverse aquatic ecosystems worldwide. In recent years, the attention has been attracted to microplastics (MPs), small plastic particles (dimensional range Daphnia magna affecting food intake, growth and reproduction. First, we performed a 24 hours uptake and 48 hours release test to assess the ingestion and elimination rate of MPs in daphnids. Already after 1 hour of exposure we found that MPs fill up the digestive tract of daphnids at all the tested concentrations. On the other hand, release of MPs in daphnids was much slower. After 24, 48 and 72 hours of exposure different sizes of MPs were still found massively in the digestive tract of treated individuals. The lack of a complete release of MPs can cause the blockage of the digestive tract and starvation, leading the crustacean to the death. Moreover, these effects can negatively affect body growth, swimming activity and, consequently, have strong consequences on reproduction, as suggest by a standard 21-day reproduction test.

TU189 Uptake of differently sized microplastics in gut passage by different species of Daphnia S. SUPIAN, University of Birmingham; I. Lynch, University of Birmingham / Geography Earth Environmental Science; J. Sadler, The University of Birmingham / Geography Earth Environmental Science Plastic-debris, for example from textile weathering and washing, are increasingly accumulating in aquatic environments, and while they are now recognized as environmental pollutants, their impact on aquatic ecosystems is not yet fully understood (Jemec, 2016). Microplastics, which are synthetic polymers with a widespread occurrence and negative effects on different trophic levels have been described (Hollman, 2013). The freshwater crustaceans Daphnia inhabit all kinds of aquatic systems and forms part of the plankton community acting as algae grazers (filtrators) and predators (raptors) making them an important indicator species in the foodchain. The Daphnia family includes species ranging in size from D. magna (2.6–3.5 mm) to D. pulex (1.3–2.0 mm) which span a similar range of sizes as micro and nanoparticles, thus suggesting that different members of this family may be differentially sensitive to or affected by different sizes of micro or nano plastics. This work presents a first analysis of the effect of Daphnia body and gut size on uptake of microplastics of different sizes. We investigated the ingestion and effects of polybead carboxylate microspheres (0.1, 1.0 and 10 μm) on freshwater cladocera of different body sizes (D. magna, D. pulex and D. galeata) after 24, 48, and 72 hours exposure to a range of mass concentrations (also compared on the basis of particle number) (Nasser, 2016). The hypothesis tested was that the size of microplastic particles preferentially taken up by the organisms will scale with organism size, due to differences in their gut sizes and filter feeding capabilities. We assessed the uptake, accumulation, and depuration of the microplastics in Daphnia species using stereomicroscope (Nikon SMZ800) measurements. Image analysis approaches (ImageJ and Matlab) were utilised to calculate gut area, and pixel density within the gut, in an effort to quantify particle uptake. This was correlated with fluorescence measurements using fluorescently labelled microplastics, corrected for the average fluorescence per particle. Rapid accumulation in the gastrointestinal tract was observed after exposure to all particle sizes in D. magna, with the smaller particle sizes being detectable in the guts of neonates of all three species. The comparative uptake and effects of polybead microplastics on D. magna, D. pulex, and D. galeata are presented here for the first time.

TU190 Determination of microplastics in mackerel stomachs by enzymatic digestion and µFTIR G. Grueiro-Noche, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); V. Fernández-González, J.M. Andrade-Garduño, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); P. Llorente, Mahia, Universidade da Coruña / Analytical Chemistry Department; D. Prada-Rodríguez, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); S. Munategui, Universidade da Coruña / Analytical Chemistry Plastic is one of the most used materials in the world and is one of the most common and persistent pollutants in the oceans. In fact, plastics constitute 60-80% of marine litter. A particular fraction of plastic debris are the so-called microplastics (µFunds ?5 mm). The presence and accumulation in the ocean is cause for concern for several reasons, one of the most important is that they can be ingested by marine biota [1]. Different studies have shown the effects on the biota, such as intestinal blockage, decreased mobility or death [2]. Microplastics can absorb persistent bioaccumulative and toxic compounds from seawater. Once ingested, the absorbed pollutants may be transferred to the respective organisms. A variety of methods has been developed to measure microplastics in biota. One important aspect of these analytical methods is the extraction of microplastics from interfering biomass. Many studies have employed one or more chemicals (KOH, H2O2) to dissolve the biomass, which can be destructive to the plastic particles and their surfaces and create interferences that were problematic for µ-spectroscopy-based analyses. Enzymatic digestion methods have been used to minimize damage to plastics [3]. An enzymatic digestion has been developed and optimized for digesting biological material without destroying microplastics. Different times and enzymes were tested to optimize the enzymatic protocol. In addition, the enzymatic protocol was compared with chemical digestion (KOH) for the treatment of mackerel stomachs. The optimized enzymatic protocol has been used to quantify the microplastics debris present in the mackerel stomach. Identification and characterization of microplastics was done by µFTIR. Acknowledgement: Financial support is acknowledged to the Program Consolidation and Structuring of Units of Competitive Investigation of the University System of Galicia (Xunta de Galicia) potentially co-financed by ERDF (ED431C-107/2018) and by the Ministry of Economy and Competitiveness (subproject AGL2017-88366-R (Funded by the Fonds BASEMAN (JPI Oceans) and project CTM2016-77945-C3-3-AR (ARPA-AUCA). References: [1] V. Hidalgo-Ruz, L. Gutov, R.C. Thompson and M. Thiel, Environmental Science & Technology 46, 3060 (2012); [2] M. Cole, H. Webb, P. K. Lindeque, E.S. Filmann, C. Hansbald and T. S. Galloway, Scientific Reports 4, 4528 (2014) [3] J. Wagner, Z.-M. Wang, S. Ghosal, C. Rochman, M. Gassel and S. Wall, Anal. Methods, 9, 1479 (2017)

TU191 Microplastic contamination of the model system Weser-National Park Wadden Sea: an across-ecosystem approach S. Moses, University of Bayreuth / Animal Ecology I; L. Schrank, C. Lorenz, University of Bayreuth / Analytical Chemistry Plastic debris, for example from textile weathering and washing, are increasingly accumulating in aquatic environments, and while they are now recognized as environmental pollutants, their impact on aquatic ecosystems is not yet fully understood (Jemec, 2016). Microplastics, which are synthetic polymers with a diameter smaller than 5 mm and extending down to the nanoscale, have a widespread occurrence and negative effects on different trophic levels have been described (Hollman, 2013). The freshwater crustaceans Daphnia inhabit all kinds of aquatic systems and forms part of the plankton community acting as algae grazers (filtrators) and predators (raptors) making them an important indicator species in the foodchain. The Daphnia family includes species ranging in size from D. magna (2.6–3.5 mm) to D. pulex (1.3–2.0 mm) which span a similar range of sizes as micro and nanoparticles, thus suggesting that different members of this family may be differentially sensitive to or affected by different sizes of micro or nano plastics. This work presents a first analysis of the effect of Daphnia body and gut size on uptake of microplastics of different sizes. We investigated the ingestion and effects of polybead carboxylate microspheres (0.1, 1.0 and 10 μm) on freshwater cladocera of different body sizes (D. magna, D. pulex and D. galeata) after 24, 48, and 72 hours exposure to a range of mass concentrations (also compared on the basis of particle number) (Nasser, 2016). The hypothesis tested was that the size of microplastic particles preferentially taken up by the organisms will scale with organism size, due to differences in their gut sizes and filter feeding capabilities. We assessed the uptake, accumulation, and depuration of the microplastics in Daphnia species using stereomicroscope (Nikon SMZ800) measurements. Image analysis approaches (ImageJ and Matlab) were utilised to calculate gut area, and pixel density within the gut, in an effort to quantify particle uptake. This was correlated with fluorescence measurements using fluorescently-labelled microplastics, corrected for the average fluorescence per particle. Rapid accumulation in the gastrointestinal tract was observed after exposure to all particle sizes in D. magna, with the smaller particle sizes being detectable in the guts of neonates of all three species. The comparative uptake and effects of polybead microplastics on D. magna, D. pulex, and D. galeata are presented here for the first time.

TU192 Photochemical fragmentation of freshwater (microplastics under UV irradiations V. Verney, CNRS ICCF / Photochimic-CVP; G. BISSAGOU KOUMBA, ICA-ICCF; F. Delor Jestin, Sigma-ICCF

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We begin to understand and describe more and more the fate of a plastic waste arriving (and remaining) in the aquatic environment. Nevertheless, we still do not know many things, for example, the time scaling of the process from the abandonment of a waste, its arrival, and its persistence in the aquatic environment. During this period, the material will be exposed to various environmental aggressions that will initiate and spread the photodegradation of the material. This scenario is accompanied by a physical fragmentation into smaller sizes, and chemical functionalization due to the photo-oxidation of the macromolecular chains. Finally, the increase in both the specific surface area and the chemical functionality may influence strongly the interaction parameters with persistent organic pollutants. We have studied, in simulated laboratory conditions, the fate of various plastics fragments (Polystyrene, Polypropylene and Polyactic Acid) immersed in fresh water and UV irradiated. We worked either with real wastes (from post-consumer sector) or with model polymers totally free of additives. The polymers were chosen for their different physical properties. Polystyrene behaves like a glass (Tg = 104 °C) at the temperatures of use, which is not the case of the PP (Tg = 0 °C). Finally, PLA can start hydrolysis reactions. During the exposure time, solids and liquids (a small volume of water) are taken for analysis. Depending on the physical and chemical properties of the agent. The presence of polymers in the environment, particularly plastics, is of growing concern, yet relatively little is known about the environmental risk these materials may pose or how this can be assessed. The CPCP industry therefore developed a risk-based prioritization framework for polymeric ingredients. Polymers are characterized by their physchem properties. Solid polymers, such as plastics, are prioritized for assessment since they are routinely detected in the aquatic and marine environment and their large size limits their contribution to the litter load. However, the fate and the distribution of these materials in the environment and the hazard of priority polymers is then assessed. When a polymer poses an unacceptable environmental risk, risk mitigation options are considered. A polymer’s physchem properties provide insights into how environmental exposure and hazard can be assessed. A decision tree was developed linking physchem properties to methods for assessing polymers. Depending on a polymer’s properties and how these may change in the environment, polymers are either assessed following existing polymer assessment guidelines (such as those prescribed by USEPA) or use of novel methods. The work presented provides a scientifically robust approach for accurately assessing the impact of polymers in the environment.

TU193 Characterization and Environmental Risk Assessment of Polymeric Cosmetic and Personal Care Ingredients

I Davies, Personal Care Products Council / Science

Polymers have been developed to perform a variety of functions that are central to modern living. Cosmetic and personal care products (CPCPs) contain a wide array of polymeric ingredients which are identified by the International Nomenclature of Cosmetic Ingredients (INCI). An INCI name often represents several polymers with different physical and chemical properties. This often leads to one INCI named polymer existing as several physical forms. For example, polyethylene can exist as a solid plastic microbead or a non-plastic wax thickening agent. The presence of polymers in the environment, particularly plastics, is of growing concern, yet relatively little is known about the environmental risk these materials may pose or how this can be assessed. The CPCP industry therefore developed a risk-based prioritization framework for polymeric ingredients. Polymers are characterized by their physchem properties. Solid polymers, such as plastics, are prioritized for assessment since they are routinely detected in the aquatic and marine environment and their large size limits their contribution to the litter load. However, the fate and the distribution of these materials in the environment and the hazard of priority polymers is then assessed. When a polymer poses an unacceptable environmental risk, risk mitigation options are considered. A polymer’s physchem properties provide insights into how environmental exposure and hazard can be assessed. A decision tree was developed linking physchem properties to methods for assessing polymers. Depending on a polymer’s properties and how these may change in the environment, polymers are either assessed following existing polymer assessment guidelines (such as those prescribed by USEPA) or use of novel methods. The work presented provides a scientifically robust approach for accurately assessing the impact of polymers in the environment.

TU194 Toxicological effects of irregularly-shaped and spherical microplastics in a marine teleost, the sheepshead minnow (Cyprinodon variegatus)

J Park, Korea Institute of Toxicology; J. Choi, Korea Institute of Korea KIT; Y. Jung, Korea Institute of Toxicology; S. Hong, Korea Institute of Ocean Science and Technology / Oil and POPs research group

Increasing worldwide contamination of the marine environment with plastics is raising public concern of potential hazards of microplastics to environmental and human health. Microplastics formed by the breakdown of larger plastics and thus typifies irregular in shape. The objective of this study was to compare the effects of spherical or irregular shapes of microplastics on the changes in organ dynamics, oxidative stress, gene expression, and enzyme activities in sheepshead minnow (Cyprinodon variegatus). Both types of microplastics were accumulated in the digestive system, causing intestinal distention. However, irregular microplastics decreased swimming behaviors (total distance travelled and maximum velocity) of sheepshead minnow, when compared to spherical microplastics. Both microplastics generated cellular reactive oxygen species, while molecular changes (transcriptional and enzymatic characteristics) of key genes and enzymes, respectively were differed. This study provides insights into environmentally relevant (fragmented) microplastics will help to improve understanding of their environmental impacts. Keywords: Microplastics, Sheepshead minnow, Behaviors, Gene expression

TU195 Assessment of the microplastic contamination in sediments from the French Atlantic coast

N. Phuong, Université de Nantes; L. Poirier, Université de Nantes / MMS; f. lagarde, Institute of molecules and materials of Le Mans / Institute of Materials and Molecules of Le Mans IMMUM UMR CNRS; M. Déniel, Institut des molécules et matériaux du Mans; A. Kamari, A. Zalouk-Vergnoux, University of Nantes / MMS

The ubiquitous presence of MPs has been demonstrated by scientists for recent years. They are detected in all environmental compartments: air, freshwater, aquatic organisms and particularly in marine ecosystems. Sediments are known as the most protected environmental compartment. Thus, the aim of this study was to assess the MP contamination in sediment from the French Atlantic coast. Sediments were sampled at three locations (Pays de la Loire region, France) and in two seasons: October 2015 (beginning of autumn) and March 2016 (beginning of spring). Firstly, different protocols (with or without digestion step) were tested according to the literature and the most appropriate was validated spiking 23 g of sediment samples in triplicates with 4 different MP types: polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC) and polyethylene terephthalate (PET). MP extraction from sediments was performed using milliQ-water with centered centrifugation. After a filtration step, MPs were detected and identified directly on the membrane filters using µPTIR spectroscopy in reflection mode. Then, a test was performed in order to determine the replicate number required to obtain a robust study. Due to highly representative samples of the whole sediment collected in the field, MPs were found in each location and for each season. Average levels ranged from 38 (+ 46.72) to 102 (+ 105.37) MP kg per kg of dry sediment (N = 10; 250 g). Ten different compositions of MPs were defined by µPTIR with a high proportion of PE and PP, 38 and 23% respectively. Five MP types (PE, PP, PVC, polyurethane and polyester) represented more than 90% of MPs. Interestingly, information of MP characteristics supported the explanation of the source and also the long-time passed in marine environment. None of significant differences were found among six sample groups. This work provides the first dataset on the level of contamination in sediments from the French Atlantic coast.

TU196 Challenges in implementing legal frameworks for assessing water quality : the cases of the EU and Swiss approaches

N. Chevè, M. Milano, E. Bernard, University of Lausanne / Faculty of Geosciences and Environment

Human activities have a great impact on river quality. Monitoring programs show that multiple chemicals are present in water and that physico-chemical properties and runoff/dissolution capacity of rivers evolve due to climatic changes. These changes can affect the aquatic ecosystems as well as the amount of useable water. It is therefore crucial to evaluate the state of river systems using a holistic approach. The European Commission established a framework to highlight rivers’ ecological deficits and to enhance regional or local water management plans. In Switzerland, such a framework is currently under development. In this study, we compared both procedures and implemented them in a Swiss catchment dominated by agricultural activities. The goal was to identify challenges linked to the application of these approaches. Both frameworks highlight that no section of the river currently meets a good environmental state and that the latter deteriorates as tributaries and wastewater discharge flow into the main riverbed. Chemical issues and water quality changes due to hydro-climatic variations and management strategies were also pinpointed. Both frameworks are thus able to highlight the main problems of the river and are consistent with each other. They are thus useful tools to survey the spatial and temporal evolution of rivers quality. However, several challenges remain, especially regarding the strategies to monitor and analyze chemicals, the definition of target values and conditions, the evaluation and integration of human-induced-pressures, and the overall evaluation of the rivers state. Development of integrated indicators is seen as a potential solution to explore river health and to provide efficient restoration measures by water managers.

TU197 Updating the Environmental Quality Standards for the EU priority substance chlorpyrifos

M. Wildi, Ecotex Centre CH / Ecotoxicology; M. Casado-Martinez, Centre Ecotex; M. Junghans, B.J. Ferrari, Centre Ecotox EAWAG; I. Werner, Ecotex Centre Eawag-EPPFL / Department of Anatomy Physiology and Cell Biology

Chlorpyrifos (CPF) is widely used as an active ingredient in insecticides. Since 2005 CPF is a priority substance under the EU Water Framework Directive (WFD) with an AA-EQs of 0.033 mg/L and a MAC-EQs of 0.1 mg/L. The aim of this study was to update the Environmental Quality Standards (EQS) for chlorpyrifos based on the current data and the WFD method for EQS derivation published in 2011. Both AA-EQs and MAC-EQs were decreased by more than one order of magnitude. The original AA-EQs was not derived based on available chronic ecotoxicity data but was set as MAC-EQs divided by a factor of 3, while the revised value of 0.00046 mg/L is based on a NOEC for A. baucha taken from the EESA authorisation dossier and set as an assessment factor (AF) of 10. The original MAC-EQS was derived from mesocosm NOECs using an AF of 1. The revised MAC-EQS of 0.0044 mg/L is based on an HC3 from a species sensitivity distribution (SSD) for crustaceans and insects using
The lowest effective AF of 5. The SSD reveals branchiopod and amphipod being the most sensitive taxonomic groups for CPY. A re-evaluation of old and new mesocosm data showed that using the available mesocosm data for EQS derivation is likely to be underprotective for amphipod. The original EQS dossier from 2005 contains no specific EQS derivation for sediment. It was concluded that “Protection of sediment [is] covered by the QS referring to the pelagic community”. The data set used for the LD50/100 study for chronic toxicity are data for sedimentary ecosystems with effect data ranging from 0.324 mg/kg dw (acute) to 0.032 mg/kg dw (chronic). Acute data suggest that the amphipod *H. azteca* might be as sensitive as CPY to the insects *C. riparius* and *C. tentans* but chronic data are only available for insects. The resulting sediment EQS$_{sed,AF}$ of 0.32 µg/kg dw was derived by applying an AF of 100 on the chronic NOEC for *C. riparius*. For comparison, also the equilibrium partitioning method was used to derive an EQS from the revised AA-EQS. The application of this model including an AF of 10 that covers uptake by ingestion resulted in a EQS$_{sed,AF}$ of 0.016 µg/kg dw. Without this AF, the EQS$_{sed,AF}$ would be in the same order of magnitude as the calculated EQS$_{sed,AF}$. Based on our EQS update we strongly recommend to revise the current EQS values for CPY.

**TU198**

Lead exposures in European Freshwaters: are they a risk? A regulatory assessment accounting for bioavailability

I. Wilson, A. Peters, G. Merrington, wca; J. Chowdhury, International Lead Association / Senior Scientist -Environment

Lead (Pb) is a chemical for which one EQS has been set and is applied across all countries. Following the introduction of the EQS (Environmental Quality Standard) is used in Europe is through a compliance assessment, effectively a comparison of the measured concentration of the chemical of interest in a water sample and the EQS. An indicative tiered compliance assessment of the European-wide bioavailable lead EQS of 1.2 µg L$^{-1}$ (EQSbioavailable) was undertaken to address regulatory freshwater monitoring data from six European member states and FOREGS database. A tiered approach to compliance assessment is possible for a bioavailable Pb concentration and can be accounted for, by correcting the measured dissolved metal concentrations in the water sample to a bioavailability-based concentration to be compared to an EQSbioavailable. In Tier 1 measured concentrations were compared against the EQSbioavailable. In Tier 2, Bio-net, a user-friendly tool based upon Biotic Ligand Models (BLMs) was used to account for bioavailability along with the current European Water Framework Directive lead dissolved organic carbon correction (DOC-WFD) approach. The outputs from both approaches were compared to the Biotic Ligand Model (BLM), the final tier in the tiered approach. Lead exposures are relatively low across all regulatory datasets and FOREGS. At Tier 1, only 3.9% of sites and samples assessed have a dissolved Pb concentration of greater than or equal to the EQSbioavailable. The Pb concentrations in European Freshwaters, as tested with regulatory monitoring datasets is relatively low. Of 8257 samples from 443 sites taken from regulatory monitoring records from six member states 71 samples showed an exceedance at Tier 3 (0.3%) with a maximum RCR of 5.32. For the FOREGS dataset, 2% of the sites assessed assessed had a concentration greater than or equal to the EQS, and at tier 3, 1 site had concentrations failing to meet the EQSbioavailable. The Pb concentrations in European Freshwaters are relatively low across all regulatory datasets and FOREGS. The results indicate that the European freshwater bodies are relatively low across all regulatory datasets and FOREGS. At Tier 1, only 3.9% of sites and samples assessed have a dissolved Pb concentration of greater than or equal to the EQSbioavailable. The Pb concentrations in European Freshwaters, as tested with regulatory monitoring datasets is relatively low. Of 8257 samples from 443 sites taken from regulatory monitoring records from six member states 71 samples showed an exceedance at Tier 3 (0.3%) with a maximum RCR of 5.32. For the FOREGS dataset, 2% of the sites assessed assessed had a concentration greater than or equal to the EQS, and at tier 3, 1 site had concentrations failing to meet the EQSbioavailable.

**TU199**

Assessing compliance of European Freshwaters for copper: accounting for bioavailability

A. Peters, I. Wilson, G. Merrington, wca; D. Heijerick, ARCHE; S. Baken, European Copper Institute

The importance of accounting for bioavailability in understanding the effects of metals has long been recognised in terms of setting environmentally relevant regulatory limit values. Attempts to deliver practical, routine methods to do so have been limited. For regulatory purposes in Europe an agreed Environmental Quality Standard (EQS) for a substance must be a fixed value: the same EQS is applied for all waters, regardless of pH and calcium concentrations. To date, the EQS must be set for the bioavailable forms, and it is termed EQS$_{bioavailable}$. This study determines the levels of compliance of European freshwaters with a copper EQS, and evaluates the usefulness of a tiered approach to compliance assessment for copper. The first tier compares the dissolved metal concentration to a threshold, estimated using either regional or continental water chemistry data. At Tier 2, the bioavailable metal concentration is calculated using the physico-chemistry of the water body, and compared to the EQS$_{bioavailable}$. It follows that the thresholds at Tier 1 must be set at a level which will ensure protection of sensitive environments. The value of the threshold has important implications in terms of the financial costs of the compliance assessment. For copper, setting the thresholds at the same level for the whole of Europe (i.e. continental) would leave some countries with costly and unnecessary monitoring requirements. Deriving the threshold on a region or country specific basis enables effective use of resources without compromising on the level of protection. A very high level of compliance for copper is observed where bioavailability based thresholds are used for the implementation derived from regionally relevant water chemistry data (99.3%). Sites where elevated ambient background levels of copper are combined with very high bioavailability, principally when the waters have low DOC concentrations, are those most likely to be at risk due to copper exposures.

**TU200**

Are lead exposures a risk in European freshwaters? A map of EQS compliance assessment accounting for bioavailability

J. Chowdhury, International Lead Association / Senior Scientist -Environment; A. Peters, I. Wilson, G. Merrington, wca

Lead (Pb) is a priority substance for which the bioavailable Environmental Quality Standard (EQS$_{bioavailable}$) of 1.2 µg L$^{-1}$ has been set under the European Commission directive 2013/39/EU for application across all countries in Europe. In the present study, a tiered approach was applied to undertake a compliance assessment of the EQS$_{bioavailable}$ using the FOREGS database that includes paired data for water quality parameters and measured Pb concentrations from freshwater streams and rivers across Europe. In Tier 1 measured dissolved Pb concentrations were directly compared against the EQS$_{bioavailable}$. In Tier 2, Bio-net, a user-friendly tool based upon Biotic Ligand Models (BLMs) was used to account for bioavailability, along with the current European Water Framework Directive lead dissolved organic carbon correction (DOC-WFD) approach. The outputs from both approaches were compared to the chronic Pb Biotic Ligand Model (Pb BLM), the final tier in the tiered approach. The maximum Pb concentration in FOREGS is approximately 11 µg L$^{-1}$. At Tier 1 screening, only 16 (2.0%) water samples of the whole dataset (n=797) have Pb concentrations that are greater than the EQS of 1.2 µg L$^{-1}$. The exceedences further decreased to 3 (0.4%) and 1 (0.1%) upon accounting for bioavailability at Tier 2 and 3, respectively. The map of site-specific PNECs (predicted no effect concentrations) as calculated by the Pb BLM identifies that the most sensitive waters in the database are all those with extremely low concentrations of DOC (<0.5 mg L$^{-1}$). The greatest frequencies of such sites are found in the Alps and Norway. The lowest PNEC values for Pb are around 0.5 µg L$^{-1}$, and the WFD EQS value of 1.2 µg L$^{-1}$ is equivalent to approximately the 4th percentile of the dataset. The results indicate that the European freshwater bodies with low anthropogenic pressure are unlikely to fail the compliance with the EQS, with the exception of very local situations such as historic mining sites.

**Integrated approaches in ecotoxicology: bridging the gap between experimental toxicology and mechanistic modelling (P)**

*TU201*

Modelling survival under chemical stress. A comprehensive guide to the GUTS framework

T. Jager, DEBTox Research / Dept of Theoretical Biology; R. Ashauer, University of York / Environment

Testing, analysing and predicting the lethal action of chemicals on organisms plays a central role in the fields of ecotoxicology and toxicology, both for scientific and regulatory purposes. The dominant approaches to deal with survival data are descriptive, focusing on standardised tests and simple summary statistics (such as the LC50). Such descriptive methods ignore the fact that lethal effects develop over time, thereby leading to biased assessments and precluding useful predictions to untested exposure scenarios. Making sense of toxic effects over time requires mechanistic models, and, more specifically, the explicit consideration of toxicokinetics and toxicodynamics (TKTD). For the endpoint survival, almost all existing TKTD models can now be viewed as special cases of a single framework: GUTS, the General Unified Threshold model for Survival. GUTS was conceived in 2010, and has since gradually gained a large user community. Furthermore, the model is receiving increasing interest from the regulatory field as it is explicitly suited for the analysis of survival data, and for extrapolation across different exposure scenarios. With the increasing interest in GUTS, and the increasing interest in good-modelling practice, it is time for a more detailed treatise on this model framework. In a CEFIC-LRI funded project, we have prepared an extensive e-book on GUTS (which will be available for download, free of charge, January 2018). The book contains a detailed description of the model framework (concepts, underlying assumptions and mathematics) and its historical roots, as well as worked-out case studies, guidance for users of the model (or its results), and the results of a ring test for a range of software implementations. This book is the standard work on GUTS modelling, and the e-book format allows the contents to be kept up to date with the major novel developments in this area.
which effects start to appear. Once this threshold is surpassed the amount of effect is calculated using a linear regression, i.e. effects increase linearly with increasing concentration. In other areas of the risk assessment dose-response modelling and the derivation of reliable dose-response curves has received much focus (see e.g. the new EFSA guidance on benchmark dose modelling). Therefore, it is investigated in the present study if these models can be improved by considering more typical dose-response curves, which often are sigmoidal shaped. This is investigated when the specific shape of a dose-response model affects the outcome of an assessment and how the magnitude of predicted effects is affected.

TU203 Investigating toxicokinetics of emerging pollutants (PFASs) in the common sole (Solea solea) from in situ measurements and experimental data on PCBs within a DEB-based modelling approach.
F. Mounier, National Research Institute of Science and Technology for Environment and Agriculture - Iresta / UR EABX; V. Loizeau, IFREMER / UR Biogeochemistry and Ecotoxicology; L. Pecqueur, IRD / UMR LEMAR; P. Labadie, UMR CNRS / EPOC Universite Bordeaux / UMR 5805 EPOC; G. Munoz, Universite de Montreal / Chemistry; H. Budzinski, CNRS / UMR 5805 EPOC; J. Lobry, Iresta / UR EABX
In the context of global change, developing mechanistic tools integrating the influence of environmental factors on toxics bioaccumulation dynamics is required, as organisms will face unprecedented conditions. Mechanistic models based on the Dynamic Energy Budget (DEB) theory are relevant to predict individual's solute accumulation and transport in birds with different temperature and food availability and quality, and contamination. Moreover, this modelling framework allows including adverse effects (DEB-tox), often based on internal concentration. However, for emerging compounds like PerfluoroAlkyl Substances (PFASs), toxicokinetics calibration is a challenge as their properties are not fully characterized yet and experiments are scarce. We here present the results of a research project at investigating toxicokinetics (TK) of PFASs in juvenile common sole from a contaminated nursery ground, the Gironde Estuary (France). In such a highly fluctuating environment, our goal was to extract information from the large variability observed in the measurements for several polychlorinated biphenyls (PCBs) and PFASs. First, we designed environmental scenarios and prioritized environmental sources of individual-variability using a mechanistic model calibrated for CB153 thanks to experimental data. As CB153 is poorly biotransformable in fish, its bioaccumulation in juveniles mainly relies on the ingestion of contaminated food. Further, we considered this congener as an additional tracer of potential preys in the wild. Indeed, diet reconstruction from stomach contents and isotope data provided us with contrasted pictures. We produced a field-specific calibration for a range of environmental diet, food contamination and temperature scenarios. Comparing these predictions with in situ measurements, we were able to highlight the major influence of diet composition. The next step was to consider the other PCBs and PFASs with previously selected environmental scenarios. Discrepancies between model predictions and observations allowed us to formulate new modelling hypotheses taking into account the individual's solute accumulation and transport in birds with different temperature and food availability and quality, and contamination. Environmental scenarios were major sources of variability provided new insights on the differential bioaccumulation between toxicant families in a key flatfish resource.

TU204 Investigating metabolic acceleration in dynamic energy budget models of copepods using the ecotoxicological model organism Nitocra spinipes
J. Koch, GfEnToxLab (Ghent University) / Applied Ecology and Environmental Biology; K. De Schamphelaere, Ghent University (UGent) / Applied Ecology and Environmental Biology
Copepods form an essential part of marine ecosystems and constitute a large portion of animal biomass on earth. Moreover, their small body size and short life cycle make them convenient test organisms in ecotoxicity studies. Beside acute toxicity, glutathione peroxidase (GPx) activity was significantly suppressed in elevated temperature. In contrast, daphnids showed significantly enhanced catalase (CAT) activity. Both enzymes are involved in peroxide metabolism and metabolic stress ecology and conservation of this species. Present study evaluated the effects of temperature (20 °C and 25 °C) on oxidative stress and life-history traits of Daphnia magna in short-term (5 days) and long-term (21 days) exposures. D. magna exposed to 25 °C exhibited continuous higher production of reactive oxygen species (ROS). In short term exposure, glutathione peroxidase (GPx) activity was significantly suppressed in elevated temperature. In contrast, daphnids showed significantly enhanced catalase (CAT) activity. Both enzymes are involved in peroxide metabolism and metabolic stress. Lower lipid peroxidation (LPO) level at elevated temperature under prolonged exposure suggests that antioxidant enzymes successfully prevented ROS-mediated damage. In addition, exposing D. magna to elevated temperature significantly shortened time to first brood, brood size, and body length, but induced significantly higher male production (p < 0.05). Reduced body length at elevated temperature indicates that D. magna under long-term exposure in the Baltic is more vulnerable to change in food quality/quantity and can lead to down-stream consequences on reproductive success. The results offer new insights into physiology and ecology of Baltic grey seals with the potential to lead to novel approaches for the study of stress ecology and conservation of this species.

TU205 Evaluation of thermal stress on Daphnia magna using oxidative stress and life-history trait parameters
H. JM, J. Na, J. Jung, Korea University / Environmental Science and Ecological Engineering
The present study evaluated the effects of temperature (20 °C and 25 °C) on oxidative stress and life-history traits of Daphnia magna in short-term (5 days) and long-term (21 days) exposures. D. magna exposed to 25 °C exhibited continuous higher production of reactive oxygen species (ROS). In short term exposure, glutathione peroxidase (GPx) activity was significantly suppressed in elevated temperature. Lower lipid peroxidation (LPO) level at elevated temperature under prolonged exposure suggests that antioxidant enzymes successfully prevented ROS-mediated damage. In addition, exposing D. magna to elevated temperature significantly shortened time to first brood, brood size, and body length, but induced significantly higher male production (p < 0.05). Reduced body length at elevated temperature indicates that D. magna under long-term exposure in the Baltic is more vulnerable to change rather than growth and reproduction to cope with the thermal stress. Moreover, a multi-generational study was performed to evaluate multigenerational effects of elevated temperature on D. magna.

TU206 Transport-protein metal binding links uptake biodynamics for predicting copper in tilapia
Y. Chen, Kaohsiung Medical University / Biomedical Science and Environmental Biology; W. Chen, Kaohsiung Medical University / Department of Biomedical Science and Environmental Biology; C. Liao, National Taiwan University / Department of Biomedical Science and Environmental Biology; C. Lisboa, University of Lisbon / Department of Biomedical Science and Environmental Biology
Metal could bind to transport protein, then accumulate in the cellular and tissue. It points out that the metal ion accumulating in target subcellular compartment could reflect the metal toxicity. Copper (Cu) plays an essential role in cellular metabolism of aquatic organisms, but it would cause toxicity with excessive accumulation. The purpose of this study was to conduct the short-term exposure experiment to examine the Cu accumulation in tilapia, then combined with bioavailability and subcellular partitioning to estimate the Cu binding situation and mechanism of toxicity on gill. We developed a mathematical framework that quantified the Cu affinity and the amount of transport protein in different subcellular compartment. Results indicated that Cu accumulation in metabolically active pool (MAP) preferred to organelles than heat denatured protein, and Cu accumulation in metabolically detoxified pool (MDP) was metal rich granule. The estimated parameters of maximum Cu influx rate, total number of transport protein and affinity constant didn't have significant differences between MAP and MDP. However, the conditional stability constant of MDP 0.45±0.005 μg l⁻¹ was
significant higher than that of MAP 0.269±0.018 ml μg⁻¹ (p < 0.001), and the uptake rate constant of MDP 0.128±0.001 ml g⁻¹ hr⁻¹ was also significantly greater than that of MAP 0.086±0.001 ml g⁻¹ hr⁻¹ (p < 0.001), it revealed that Cu was likely to bind on MDP in the low exposure concentration than that of MAP. This study concluded that Cu tends to accumulate in MDP, then may cause less toxicity to tilapia. Keywords: Copper; bioavailability; transport protein; subcellular partitioning

TU208

Relationships between subcellular metal partitioning and biomarkers of effects in white suckers (Catostomus commersonii) exposed to an environmental metal gradient

N. Urien, INRS-ETE / Centre Eau Terre Environnement; A. Urien, Université du Québec / Centre Eau Terre Environnement; L. Ramilo, H. Sonnenberg, Ecological and Regulatory Solutions Inc; P.G. Campbell, P. Couture, Université du Québec, INRS / Centre Eau Terre Environnement

Discharges from metal mining operations may lead to metal accumulation and toxicity in aquatic species. Once metals enter cells, they can bind to sensitive components and cause deleterious effects. Nevertheless, metals can also be detoxified by binding to molecules designed to sequester them, limiting their toxicity. The objectives of this study were (i) to assess the subcellular distribution of metals and metalloids (Cd, Cu, Se and Zn) in layers of white suckers exposed to metal-mining effluents, and (ii) to investigate the links between the binding of specific metals to particular subcellular fractions and physiological effects. To this end, mature male and female fish were collected in three lakes downstream from a metal-mining effluent and one lake in a reference area. Subcellular partitioning among putative metal-sensitive fractions (MSF) and biologically detoxified fractions (BDM) in layers was determined after differential centrifugation and heat-denaturation steps. In parallel, a suite of biomarkers was investigated ranging from general indicators of energy accumulation to specific indicators of oxidative stress and metabolic or biosynthetic capacities. Total hepatic metal concentrations were strongly linked to higher exposure fish than in reference fish, with Cd (x5) and Se (x10) being accumulated the most. No differences between sexes were observed. Subcellular partitioning of metals was similar among areas but specific to metals; over 70% of the Cd burden was found in the heat-stable cytosolic proteins fraction, which includes metallothioneins. In contrast, the largest contributors to the total Se liver burden were the potentially metal-sensitive heat-denaturable proteins fraction (~35%) and the organelles fraction (~30%). These results suggest that Cd was well detoxified and regulated by white suckers, whereas the presence of relatively high Se concentrations in the MSF suggests that exposed fish were likely subject to stress. Principal component analysis showed that increasing [Se] in all of the fractions was strongly correlated with lower fish condition and associated with higher copper and zinc content. These results suggest that Cu and Zn compete for the heat-stable cytosolic protein fraction by forming CuZn-SH-2 complexes. CuZn-SH-2 has a tissue-specific distribution and its role in fish is not yet known. Finally, this work will contribute to advancing our understanding of the toxic modes of action of metals in aquatic organisms and our capacity to monitor the risk for fish inhabiting metal-contaminated environments.

TU209

Development of an adverse outcome pathway for acetylcholinesterase inhibition in zebrafish (Danio rerio)

K.H. Watanabe, A. Mikhail, Arizona State University / School of Mathematical and Natural Sciences; K. Conrow, Arizona State University; N. Vinas, Mississippi State University / Engineer Research and Development Center

Acetylcholine is a neurotransmitter that is important for a broad range of processes in the body such as muscle activation. Acetylcholinesterase (AChE) is an enzyme that hydrolyzes acetylcholine in order to eliminate it from the body, and when AChE is inhibited acetylcholine levels increase. Excess acetylcholine at cholinergic synapses overstimulates muscarinic- and nicotinic-type receptors. These receptors are found in most organs of the body, thus multiple adverse outcomes may result. Moreover, a wide variety of chemicals including organophosphates, carbamates and some high nitrogen compounds, can inhibit AChE. Thus, the impact of AChE inhibition in large, yet relatively little research has been focused upon developing related adverse outcome pathways (AOPs) or a network for this molecular initiating event. This presentation focuses upon the construction of adverse outcome pathways that result from AChE inhibition in zebrafish (Danio rerio). We performed a comprehensive review of the literature to identify studies and datasets that could be used to construct an AChE AOP. Adverse outcomes include seizures, impairment of the retina architecture and behavioral changes. Preliminary AOPs for these outcomes will be presented with references to the studies that support the AOP, and identification of data needed for quantitative AOP development.

TU210

Development of a Novel Quantitative Adverse Outcome Pathway Predictive Model for Lung Cancer

T. Hill, US EPA NHEERL/ISTD/CB / ORD NHEERL Integrated System Toxicology Division; R. Conolly, US EPA RTP

Traditional methods for carcinogenicity testing are resource-intensive, retrospective, and time-consuming. An increasing testing burden has generated interest in the adverse outcome pathway (AOP) concept as a tool to evaluate chemical safety in a more efficient, rapid and effective manner that better directs resource utilization. A central premise of the AOP concept is that pathway progression from the molecular initiating event (MIE) implies a definable “response-response” (R-R) relationship exists between each key event (KE) that drives the pathway towards the adverse outcome. Computational description of these R-R relationships in a quantitative AOP (qAOP) enables dose-response consideration of probabilities and uncertainty, as well as flagging of special at-risk populations or sentinel species. The qAOP also provides a platform to utilize early genomic and in vitro data streams for rapid, limited-intensity predictions as well as the development of support tools that inform the level of risk. This poster describes a novel AOP/qAOP for lung cancer in the mouse from the MIE of CYP2F2-specific formation of reactive metabolites, advancing through KE for protein/nuclear acid adducts, diminished CC10 capacity and hyperplasia of CC10 deficient Clb cells, and culminating in the adverse outcome of mixed-cell tumors with invasive potential in the in vivo carcinogenesis space. The AOP is independent of route of exposure and grounded in overlapping mechanistic events for naphthalene, styrene, ethyl benzene, isoniazid and fluensulfone in the mouse. The qAOP modeling is supported by defined mechanistic relationships and quantitative data (PB-PK, dose-response and time-course) from archival data in peer-reviewed literature. Findings will include evaluation of data supporting the cancer qAOP, suitability for characterization of R-R relationships, and identification of data gaps or additional research as required. This approach supports international efforts on use of quantitative effect thresholds for adversity predictions and incorporation of novel data streams into the cancer risk assessment process. This abstract does not necessarily represent the views or policies of the U.S. EPA.
Integrating life cycle approaches towards a sustainable circular economy (P)  

TU214  
Metal and mineral resources in LCA - What’s the problem?  
R. Schulze, University of Leiden / CML; J. Guinee, University of Leiden / Institute of Environmental Sciences; R.A. Alvarezena, Z. Weng, J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology; J. Drielsma, Euromines; E. Zimmer, IBACON GmbH

The framework will be applied in a workshop with project external stakeholders and will enable a comparison of differences and overlaps between stakeholder views. The framework will be applied in a workshop with project external stakeholders and will enable a comparison of differences and overlaps between stakeholder views. The framework will be applied in a workshop with project external stakeholders and will enable a comparison of differences and overlaps between stakeholder views. The framework will be applied in a workshop with project external stakeholders and will enable a comparison of differences and overlaps between stakeholder views. The framework will be applied in a workshop with project external stakeholders and will enable a comparison of differences and overlaps between stakeholder views. The framework will be applied in a workshop with project external stakeholders and will enable a comparison of differences and overlaps between stakeholder views. 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TU219
The impact of European consumption of household appliances: insights from the LCA of efficiency measures and expected trends
F. Reale, EC JRC; V. Castellani, European Commission - Joint Research Centre / Sustainable Resources, Bio-Economy; B. Heschl, EMPA / Technology and Society Lab; S. Sala, European Commission - Joint Research Centre / Bioeconomy

Household appliances are an important contributor to the overall impact generated by European citizens’ consumption of products. In 2010 the energy-related products covered by the Ecodesign directive responsible for 53% of total EU-28 gross energy consumption and 21% of total carbon emissions. The aim of this study was to provide insights from the Life Cycle Assessment (LCA) of future scenarios of the European consumption of household appliances in the residential sector. The consumption is a Basket of Products (BoP) owned by an average European citizen. The BoP baseline consists of a process-based LCI model for a BoP that represents the most relevant household appliances in terms of energy consumption and market share: dishwasher, washing machine, drying machine, air conditioner, refrigerator, TV, screen, computer, lighting, cooking appliances. A number of scenarios have been tested, covering the various life cycle stages including scenarios on the use phase, the waste collection, the electricity mix used. An overall scenario covering the design options for products energy efficiency and expected trends in purchase and user behavior has been calculated and compared with the baseline. The baseline and evaluation (with LCA impact assessment method) confirmed the well-known relevance of the use phase of energy-related products, where the efficiency of products and consumer behaviour appear to be the two factors determining the BoP impact. Results of the scenarios assessed showed for most of the categories a reduction of the overall impact compared to the baseline scenario. The reduction is more important for categories like e.g. GWP (due to the improved energy efficiency of products) and the lower “phasing out” of nuclear energy plants in Europe) and AP (in this case, the reduction of the amount of coal-based electricity leads to reduced releases to the atmosphere of those substances contributing to AP). Due to the expected increase of the number of devices per person in the future, some of the impact categories – namely HTPc, FETP, LUC and FRD – show a stronger potential impact in the scenarios than it is in the baseline. Obtained results show clearly that just heading for more efficient devices is a necessary, but not yet a sufficient condition towards more sustainability; we as a society have also to re-evaluate the way we acquire (more and more) such devices and are spending more and more time behind them – here some limitations may would make sense.

TU220 Assessing economic and environmental effects of product replacement program using dynamic discrete choice model: As a case study of “home appliance eco-point system” in Japan
D. Nishijima, National Institute for Environmental Studies; S. Kagawa, Kyushu University; M. Oguchi, K. Nansai, National Institute for Environmental Studies

In evaluation and estimation of environmental burdens from consumer durables, product lifecycle is a key factor and most of the previous studies used average lifetime or lifetime distribution with a focus of engineering durability (Müller 2006; Kagawa et al., 2011; Nishijima, 2016). These product lifetime modelling techniques did not explicitly treat a relationship between product replacement and consumer’s behavior. Whereas, the product replacement modelling techniques based on the economic maximum utility theory have been developed in economics and marketing fields (Schiraldi, 2011; Melnikov, 2013). It is beneficial to apply the economic product replacement models to environmental research. This study attempts to use the product replacement model for evaluating economic and environmental effect of polices for consumer durables. As a case study, we focused on air conditioners and analyzed the economic and environmental impacts of “home appliance eco-point system” in Japan which was conducted during a period from May 2009 to March 2011 for encouraging consumers to replace their own products with new ones. Following the preceding studies (Rust, 1987; Gordon, 2009;), we constructed the product replacement model of air conditioners in Japan by Bellman equation and a dynamic discrete choice model. We also estimated the logit parameters by the maximum likelihood estimation method. We used the annual sales and replacement data of air conditioners during 1993 to 2015 (The Japan Refrigeration and Air Conditioning Industry Association; The Japan Electrical Manufacturers’ Association) and replacement and running cost data during the same period (Agency for Natural Resources and Energy of Japan; The Japan Refrigeration and Air Conditioning Industry Association). Using the estimated product replacement model, we analyzed the impact of “Home appliance eco-point system” on the CO2 emissions and economic output by input-output framework. Through the results, we not only evaluated how effective the system was for reducing CO2 emissions and stimulating economy in Japan, but discuss how we could improve the system for obtaining more economic and environmental benefits.

TU221 Economic lifetime, hazard functions, and car inspection system
Y. NAKAMOTO, S. Kagawa, Kyushu University

Under the Paris Agreement adopted at COP21, Japan set itself a target of reducing its territorial greenhouse gas emissions by 26% (relative to the 2013 level) by 2030. To further reduce emissions in the transport sector, the government has set up both a technology policy and a demand policy, to try to improve the fuel economy of new vehicles and increase sales of next-generation motor vehicles as a proportion of new vehicle sales, respectively [Ministry of Land, Infrastructure, Transport and Tourism, 2017]. By assessing and estimating the economic lifetime of vehicles on consumer behavior that maximizes utility level over time, we were able not only to specify the replacement purchase rate on a dynamic discrete choice model but also to quantitatively analyze the environmental impact of changes in consumer behavior due to the adoption of policies because a motor vehicle inspection dummy, maintenance and repair costs, and new vehicle replacement purchase costs are explicitly included in the utility functions at the time of vehicle inspection and purchase. 'In this study, we introduce a DDC model to estimate car replacement purchase rates based on consumer behavior aimed at maximizing utility levels over time. By combining replacement purchase rates specified from source data with life-cycle CO2 emissions analysis, we demonstrated the impact of Japan’s car inspection system on CO2 emissions derived from cars. The parameter estimate results obtained from our DDC model are robust, showing that car owners behave with a forward-looking perspective. In addition, it is clear that offering subsidies for car inspection costs can be expected to have a substantial effect on reducing CO2 emissions associated with the transport sector because it would dampen car replacement purchase behavior and thereby increase the average economic lifetime of cars. The results of this study show that revising Japan’s car inspection system has the potential to cause a major turnaround in existing replacement purchase behavior and contribute to car emissions contributing to cutting CO2 emissions. However, in practice, completely scrapping the current car inspection system would be very difficult. This is because, although abolishing inspections would relieve car owners of a painful cost burden, it would also put the safety of car operation at risk, due to the failure to detect problems that a car inspection would ordinarily detect.

TU222 Li-S batteries for electric vehicles, challenges for circular economy objectives
O. benveniste, C. Corchero, IREC; B. Amante, Universitat Politècnica de Catalunya UPB

The continuous and planned increase of the electrification in the transport sector is one of the main drivers of advances in energy storage for electric vehicle (EV) propulsion and present technological challenges to achieve the expected requirements. The implementation of the EVs on our roads remains a challenge and is below expectations foreseen. The elevated costs of the batteries and thus the EV cost, refrain the massive depletion of this technology. With the aim of reaching a full market penetration and the short term perspective, it is necessary to investigate new materials and configurations of EV batteries. To this end, lithium-sulfur (Li-S) batteries are the closest battery technology capable of meeting these expectations. Although Li-S can overcome the technical issues, this solution still needs to demonstrate how the socio-economic-environmental barriers associated are solved, above all when considering their fitting in a circular economy society. There are no clear evidences of the environmental benefits due to the use of Li-S batteries as an alternative to Li-ion batteries. Moreover, there is still unclear of how these batteries should be treated at their end of life with the aim of recovering the maximum amount of valuable materials. This study focuses on the methodological design to analyze the environmental and social aspects related to Li-S batteries using LCA perspective in a circular economy context. This research has the following objectives: 1) To evaluate their environmental profile; 2) To identify their potential use in a second life, once they cannot be used in an EV (e.g. their use in stationary applications); 3) To evaluate the associated environmental impacts and potential benefits due to material recovering using batteries recycling options. These objectives present a considerable number of challenges due to the lack of data in the Li-S data inventory collection, the uncertainties due to the feasibility of using them in second life and the lack of examples to analyze economic and environmental benefits of designing a customized recycling process. For this reason, the aspects covered by this study are extremely relevant in the frame of considering Li-S batteries technology as a suitable system within the objectives of a circular economy. This research is being carried out within HELIS Project. This project receives funding from the European Union’s Horizon 2020 research and innovation program under Grant Agreement No 666221.

TU223 ATISOL C2C - Life cycle assessment as a tool for the ecosizing of a "vapor and air barrier membrane - insulated" system, in a cradle to cradle approach looking, but respectful of the Chemical Rainbow and of the Trend of Technical Engineering - PEPS; M. Getlicher, Derbigni; B. Colson, Sieno Flett & Filtration; I. De Vilder, Centexbel; A. Tilmanes, Belgian Building Research Institute (BBRI); A. Léonard, Liège Université / Chemical Engineering - PEPS

The European directive on the energy efficiency of buildings requires the members to put on the market solutions for insulation of buildings that are simple, effective and lasting, but also respectful of the environment and the users. To reduce energy losses and to guarantee the durability of the thermal insulation, it is necessary to have a vapor and air barrier on the warm side of the building, situated between the thermal insulation and the inside. Hence the passage of moisture from...
the building is reduced, preventing condensation problems on the insulating material. Currently, the implementation of an insulation system combined with a vapor barrier presents three major problems: an important time for placing, a random durability in time (stability of tapes of junction, adherence to the existing walls, puncting resistance), and finally a low disassembly and re-use level. The ATISOL C2C project aims to develop a complete solution (ecological insulation + recycling technologies) that can promote a circular economy. Due to the self-adhesive characteristics, the implementation is made easier in both common surfaces (walls, roofs and ceilings) and to the level of detail such as corners and junctions. In addition, the application of a clay finishing coating on the membrane completes the offer. The constructive system can be dismantled at the end-of-life of the building and the various elements are recovered and valued in a cradle-to-cradle perspective. A full assessment is already carried out: the Delphi method. The preliminary life cycle assessment results support the technical partners along the whole development and evolution of the membrane by pointing out the hotspots of the system, from the choice of the components of the vegetal binder or the spunbond reinforcement to the manufacturing process. This project is supported by the GreenWin Competition Clusters and subsidized by the Walloon Region (BE).

TU224 Life Cycle Assessment of Recycled Asphalt and Biomaterials for Road Pavements
A. Jimenez del Barco Carrion, The University of Nottingham; D. Lo Presti, The University of Nottingham / Nottingham Transportation Engineering Centre NTEC Transportation, higher education institutions in the UK and road agencies and road authorities is the most important mean of transport. To build and maintain roads is essential to ensure the efficiency and keep up the level of this service. However, these operations require a high consumption of non-renewable and raw materials (aggregates and petroleum-based materials) which is one of the major concerns nowadays in this field. To address this issue, the use of recycled materials in pavement engineering has become very popular in the last decades. In addition to the raw material saving, recycling reduces costs and save landfill space. In this regard, the increase of recycling rates of asphalt materials, aiming at 100%, is key to move towards the implementation of a sustainable circular economy in pavement engineering. However, the amount of recycled material that can be used in a pavement is limited due to some factors. One of the main factors is the cold mixability. Due to this issue, if high recycled asphalt amounts are to be used in asphalt mixtures, the recycled material has to be treated and new components have to be added in the asphalt mixture. These processes and new components may hide the advantages of using recycled materials from the environmental and economical point of view. Within the ERA-NET Plus InfraVation 2014 Call, the project BioRePavation analysed three alternative biomaterials to be included in high-recycled asphalt content mixtures to help increase recycling rates in an European case study. A comparative full Life Cycle Assessment of the asphalt pavements was carried out for each alternative to determine whether the use of recycled asphalt mixture in high amounts including biomaterials still entails environmental advantages. From a preliminary analysis of the results, it is possible to affirm that using the asphalt mixture with higher high-recycled asphalt content and road the carbon footprint than the asphalt mixes currently used in Europe. This type of study is needed in order to encourage road authorities to use innovative technologies that can promote a circular economy.

TU225 Dynamic vs static LCA to explore the sustainability of industrial waste recycling
A. Di Maria, KU Leuven / MTM; A. Levasseur, École de technologie supérieure / Construction engineering; K. Van Acker, KU Leuven / Materials Engineering
LCA methodology is often used to promote the circular economy in the construction sector. However, it can sometimes create an illusion in terms of the environmental benefits of a given action. For example, design, recycling and cascade use of resources. To address how sustainability changes with scale, sector-wide scenarios for different measures and changes in market shares will be constructed through a CLCA approach. Opportunities and challenges for the specific sector and context will be identified to include side effects and to ensure assessing realistic pathways. In this way, the framework adapts to the specific requirements of each sector. To interpret the results in relation to the safe operating space, the planetary boundaries will provide reduction targets. This will be done by following existing proposals on the integration of LCA results into the planetary boundaries approach. By combining a bottom-up CLCA approach with a top-down planetary boundary framework, we provide a method that can take stock of “real” environmental sustainability progress, at different scales and thereby help companies, cities and countries to understand the environmental implications of CE strategies. This might enable the integration of environmentally friendly CE initiatives into a variety of sectors and scales.

TU226 Supporting the sustainable circular city - is environmental accounting supporting the transition?
A. Petit-Boix, S. Leipold, University of Freiburg / Chair of Societal Transition and Circular Economy
The transition from linear to circular economies is already in the international policy agenda and several actors are implementing this concept at different scales. In particular, cities are one of the key to implement this process in the context of moving into healthier, more sustainable environments, and they thus promote a number of circular initiatives. However, do these initiatives help to achieve the goals included in local sustainability agendas? Or are they less environmentally favorable than conventional, linear systems? Systematic environmental accounting might give an answer to these questions once decision-makers have access to practice-oriented information. In this contribution, we seek to determine whether research has effectively quantified the environmental performance of the initiatives promoted in cities. To do so, we gathered the features of circular economy initiatives reported by a pool of cities to understand what they refer to when addressing circular economy. At the same time, we reviewed scientific literature that applied quantitative environmental tools to analyze case studies of circular economy practices. These tools included life cycle assessment (LCA), life cycle inventory (LCI), life cycle impact assessment (LCIA) and process-oriented optimization (POO). The results showed that there were many research gaps regarding the impacts of new strategies and a structured evaluation is needed. While research and practice are both interested in the implementation and evaluation of waste management practices, cities are engaged in a variety of initiatives that research has not explored yet, such as urban planning issues. This might put cities at a disadvantage if they are not able to select the most environmentally friendly initiatives that help them achieve their local sustainability goals while approaching circular economy.

TU227 Taking stock of a circular economy within planetary boundaries: A multi-scale analysis through consequential LCA
H. Hélander, A. Petit-Boix, S. Leipold, University of Freiburg / Chair of Societal Transition and Circular Economy
Current institutional agendas are embracing the concept of “circular economy” (CE) in order to improve the sustainability of products and services and reduce the resource dependence. CE is applied through a broad range of strategies at various scales. However, it needs to be comprehensively studied as to not to compromise the earth’s safe operating space. For this reason, consequential life cycle assessment (CLCA) provides suitable tools for understanding these changes. Our main goal is to create a methodological framework that allows the assessment of CE strategies across scales within the planetary boundaries. Two assessment levels will be considered, i.e., cities and products/sectors. The framework will be applied and tested through case studies of German products/sectors (e.g., wooden houses, car tire, packaging and food waste), as well as on European cities applying CE-related strategies. At the city level, CLCA will be combined with territorial LCA to provide information on the environmental variations associated with local CE strategies. Thus, we might be able to determine the impacts of production and consumption activities that meet the needs of a city before and after the application of CE strategies. At the product level, case studies will examine different CE strategies such as eco-design, recycling and cascade use of resources. To address how sustainability changes with scale, sector-wide scenarios for different measures and changes in market shares will be constructed through a CLCA approach. Opportunities and challenges for the specific sector and context will be identified to include side effects and to ensure assessing realistic pathways. In this way, the framework adapts to the specific requirements of each sector. To interpret the results in relation to the safe operating space, the planetary boundaries will provide reduction targets. This will be done by following existing proposals on the integration of LCA results into the planetary boundaries approach. By combining a bottom-up CLCA approach with a top-down planetary boundary framework, we provide a method that can take stock of “real” environmental sustainability progress, at different scales and thereby help companies, cities and countries to understand the environmental implications of CE strategies. This might enable the integration of environmentally friendly CE initiatives into a variety of sectors and scales.
tool to direct future research. We performed the work using Simapro 8.0 software, method Recipe Endpoint (E) and the Ecoinvent 3.0 database. First, in drinking water production, flocculants are used to remove particles, natural organic matter (NOM) and metals (like iron) from water. The sludge formed can be hydrolysed again to recover iron for production of new flocculants. Our LCA study showed that flocculants obtained from iron sludge after HCl dosage have a significant lower environmental impact than commercial and produced in situ. Recovery of FeCl₃ from iron sludge can contribute to its recycling. However, the existing patented flocculants from iron sludge are not suitable to be used in the drinking water purification or waste water treatment looks promising and this LCA study underlined that technical research into the quality of the flocculants is justified. A sensitivity analysis indicated that the iron content of the sludge is strongly determining the environmental impact; thus indicating that different types of iron sludge should be considered for further research. As second case study, we investigated water management in shale gas production, since hydraulic fracturing technologies require significant volumes of water for well development and produce high volumes of wastewater with highly variable composition. Different treatment options for waste water from shale gas production were compared in case 2. It is important to note that each process resulted in different effluent quality. Each process included a pretreatment step consisting of dissolved air flotation and biogradation, followed by either discharge directly to seawater, or treatment with vapour compression distillation (VCD) with water discharge to surface water and injection of the brine back to the deep underground formation. The LCA study on of shale gas waste water treatment indicated that more detailed information on the concentrations of compounds in the wastewater is required. A technical research into the efficiency of the VCD, to optimize compound removal from wastewater is recommended. In this study LCA has shown to be an effective tool to evaluate the direction of research within the sector, evaluate possibilities for resource recovery and determine environmental impacts of processes.

TU229 Closing the loop in a territory: LCA approaches to boost resource recovery M. Calvet, CETAQUA / MASE; M. Amores Barrero, CETAqua, Water Technology Centre; D. Marin, CETAqua, Water Technology Centre / Environment and Socioeconomics; M. Issa, CETAqua Water Technology Centre / MASE; M. Termes, CETAQUA; M. Ruiz Mateo, CETAqua Water Technology Centre The concept of Circular Economy is widely extended in political and business agendas and so is the concept of “Closing the loops”. The idea that the value of materials and products should be maintained in the economy as long as possible and wastes minimised is understood and accepted. However, its implementation is being brought to the light questions as to which level to implement it (material, product, system, business and territory), which tools to use to decide on the most appropriate circular economy solutions to develop etc. Cities, municipalities and wider geographical areas, act as accumulators of resources that in the current linear model create negative externalities. However, these waste, waste and energy flows if managed in a circular system could be valorised bringing massive opportunities to all territorial actors. This paper explores the application of the Circular Economy in two different case studies in Spain (San Feliu de Llobregat an the Circ City Region) for which a methodology has been specifically created. The methodology is validated and its effectiveness demonstrated through the identification of more than 10 Circular Economy Opportunities in each case study. The role of LCA as a tool used in different stages of the Territorial Circular Model is explored i.e. at the data inventory gathering, resource flows analysis, assessment of the most appropriate circular economy strategies and the determination of indicators to establish current levels of circularity and benchmarks. The need to develop a tool to assist in the data inventory gathering, data visualisation and materials flow analysis to identify a greater number of circular economy opportunities is also highlighted. Conclusions of the research include the need to assess the identified opportunities from a technical, economic and social perspective. The importance of the development of an action plan to assist actors in the implementation of the preferred circular economy strategy is highlighted. Finally, the importance of monitoring of the assessed impacts of the strategy is emphasised.

TU230 Innovative method to optimize territorial organic waste resources G.C. Vega, The Technical University of Denmark (DTU) / Management Engineering; J. Sohn, The Technical University of Denmark DTU / DTU Management Engineering; M. Birkved, Technical University of Denmark / QSA Dept of Management Engg A truly environmentally sustainable bioeconomy requires integrative approaches for the design and optimization of the industry to produce biobased products. A holistic approach is taken into account in order to arrive at thoughtful recommendations for future biotechnologies is proposed. The assessment incorporates common LCAs of biotechnologies with analysis of producer territories in order to provide site specific recommendations that take into consideration different geographical and feasibility constraints, the present and future energy grid, and production capabilities. The authors posit that a multi-criteria approach, such as this, can prevent unforeseen burden shifting between environmental impacts while providing implementable decision support. Method: An LCA of various biotechnologies will be conducted with the aim to provide guidance for bioenergic ecosdesign that would incorporate emerging biotechnologies and cascading products. Among these technologies, six pathways for anaerobic digestion (AD) and three different pathways to extract polyphenols will be assessed at the product level. At the territorial level a two-pronged approach will be used to achieve a representative data set for the territories, which will consist of material flow data from national and regional sources scaled down to the territory and individual producer data (primary production). The energy grid data and local benchmarks will be collected from the modules of biotechnology assessment and the foreground system at the level of the territory, in order to observe the effects of waste optimization on the territory. Results: The performance of the biotechnologies will very likely depend largely on energy consumption and the intended use of the new products viz. how the residual resources from wine production are used. At the territorial level the authors posit that local production practices, in terms of wine production will be greatly influential for global warming, eutrophication and resource depletion potentials. Fertilizer inputs, both mineral and organic, and pesticide use will very likely differ from territory to territory and will impact the above mentioned categories as well as toxicity related impact categories. Another important aspect will be the energy consumption of the territories and the influence of future energy grid greening on the future impacts of the technologies proposed today.

TU231 Environmental Benefits of a Circular Economy: Connecting Waste Type and Geographic Proximity R. Iten, K. Kelly, M. Stucki, Zurich University of Applied Sciences / Institute of Sustainable Utilisation Science The aim of a circular economy is to transform waste into resources. There is a plethora of waste and by-products that remain unused in the traditional linear industrial system. However, transformation from a linear to a circular system is challenging, limited by several constraints such as the availability of information on the specific composition of the waste, the availability in time and space of quality of waste as well as limited knowledge of the usability of such waste products. The goal of the SHAREBOX Horizon 2020 project is the development of a platform for the facilitation of synergies within the industry to enable a more circular flow of resources within the European processing industries. The SHAREBOX platform is a database of available waste and resources required by companies, enabling the transformation of waste to resources by matching supply and demand. The platform also serves as the first point of contact between different partners in a circular system. Furthermore, the platform enables the identification of new synergies overarching the different subsectors of the industries as well as optimal matching from the perspective of a circular economy. We analysed the implications of the transformation of different types of waste to resources when the industries are located in different geographic locations under consideration of the life cycle stage of transformation. Waste PET can be transported up to 10 000 km by lorry and still provide a net benefit regarding greenhouse gas emissions due to circular use. However, in case of concrete, the results are very different. A net benefit only occurs if the additional transport distance compared to primary concrete is less than 5 km. Transformation from linear systems to circular systems can substantially reduce total resource consumption as well as emissions of the whole value chain and therefore contribute to a greener economy. However, matching industries for transformations leading to the substitution of primary materials is still a major challenge. In addition, the environmental benefits of the reuse of resources is limited by the life cycle stage of the transformation as well as by additional transportation that may be required. The completeness of the scope will be crucial for the assessment and generalisations overarching different types of waste remain challenging.

TU232 Evaluation of nutrients and energy recovery technologies through Life Cycle approaches M. Ruiz Mateo, CETAqua Water Technology Centre; M. Calvet, CETAQUA / MASE; S. Lopez, CETAqua Water Technology Centre / Sanitation; M. Issa, CETAqua Water Technology Centre / MASE; Y. Lorenzo-Toja, CETAqua Water Technology Centre; D. Marin, CETAqua, Water Technology Centre / Environment and Socioeconomics Conventional treatments for wastewater treatment are characterized by a high energy consumption, mainly attributed to the oxidation (removal) of carbon and nutrients. In the current economic and environmental context, there is a necessity to find solutions and provide strategies and technologies to be able to change the current concept of Waste Water Treatment Plants (WWTPs) from being energy consumers to resource recovery sites. In the meanwhile, a huge effort is done in the current wastewater treatment to reduce the total resource consumption from the finite reserves of phosphate rock, that moreover, are located out of Europe. The LIFE RECOVERY project aims at demonstrating, by means of a prototype, the feasibility of a new wastewater treatment approach, based on energy and nutrients recovery. The process tested in the project is based on an initial pre-concentration step that promotes the biosorption process maximizing the biogas production. The efficient of the pre-concentration unit is the influent of a nutrient recovery unit based on adsorption in zeolites. The LIFE ENRICH project (Enhanced Nitrogen and Phosphorus Recovery from wastewater and Integration in the value CHain) goes a step further and aims at demonstrating the whole value chain for nutrient recovery
in wastewater treatment plants and their valorisation in agriculture through different approaches boosting a model based on circular economy. This study intends to evaluate environmentally and economically the innovative processes tested in the LIFE RECOVERY and LIFE ENRICH projects by comparing them to conventional schemes of wastewater treatment. To do so, Life Cycle Assessment (LCA) has been the selected methodology to quantify the environmental burdens of the different alternative conventional processes are located: Villanova WWTP and Murcia Este WWTP. Special focus has been put to impact on climate change, which is expected to be reduced thanks to the recovery of nutrients that could replace chemical fertilizers and due to the higher biogas production and its further valorisation. Life Cycle Costing (LCC) analysis has been undertaken in order to assess all relevant costs associated with the life cycle of both systems and not only the variable cost incurred (CAPEX and civil works) and operation and maintenance phase (OPEX costs e.g. energy, chemicals, transport) and is aimed to identify the most economic-friendly scheme.

TU23
Life Cycle Assessment of a novel process of polyhydroxyalkanoates production with waste and by-products from wine industry value chain
A. Novi, Università di Bologna / Centro Interdipartimentale di Ricerca per le Scienze Ambientali; L. Vogli, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; S. Righi, University of Bologna / Physics; S. Macrelli, R. Conti, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; D. Samori, University of Bologna / Chemical Engineering; D. Bengoa, Quantis; F. Razza, NOVAMONT; H.V. Haraldsson, Swedish gemeinnützige GmbH / Bioenergy Systems; S. Ugarte, SQ consult; J. Golaszewski, York; L. Ladu, Technische Universität Berlin; A. Koutinas, Agricultural university of Bio.

The overall objective of the project is to promote a more efficient and harmonized policy regulation framework for the market-pull of bio-based products. This will be achieved by developing a fit-for-purpose sustainability scheme, including standards, labels and certifications. An integral part of STAR-ProBio is the adoption of life-cycle methodologies to measure environmental, techno-economic and social impacts, and comprehensively assess the roll-out of bio-based products. The analysis of selected case studies on construction materials, bio-based polymers, and fine chemicals, will apply benchmarking against non-bio-based products. The project intends to study the activities of the identified environmental, social and economic criteria to be considered in the development of a sustainability scheme, the development of an LCA approach for strategic and PEF-compliant policy decision support, the sustainability interpretation of end-of-life options taking into account the EU circular economy principles, the development of a methodology to compare techno-economic sustainability of bio-based products versus their fossil-based alternatives, the identification of consumers’ sustainability preferences and expectations, the assessment of social and economic benefits of new sustainable value chains and the assessment of the status quo and description of existing approaches to quantify (direct and indirect) impacts of land use changes.

TU25
Integration of a Colombian bio-refinery from industrial palm oil waste into the circular economy
J. Torres, Universidad de la Salle / Grupo de Investigación en Gestión del Riesgo y Cambio Climático; I. Herrera, D. Garain, A. Gamaara, CIEMAT / Environment D Energy Dept Energy System Analysis Uledge for future decision making towards the circular economy approach in the Colombian palm oil industry, to account for the agriculture supplies and demands in a representative sample of the process chain. This study allows the characterization of the quantity of waste to be used in palm oil mill bio-refineries as a representative sample in order to identify potential risks. In addition, the work adds not only criteria for assessing the agricultural palm sector to establish indicators for a sustainable circular economy, but also methodologies based on Life Cycle Analysis to allow efficient management of resources, nutrients and agrochemicals in order to quantify the required amount to produce a given product. The knowledge of these parameters permits the identification of those elements that influence its magnitude, so that, different alternatives can be used to enable the sustainability of the oil palm industry. Finally, this research could contribute to develop knowledge gaps of the bio-refinery in Colombia.

TU26
CRADLE-TO-GATE LIFE CYCLE ASSESSMENT OF BIOGAS PRODUCTION FROM PALM OIL MILL EFFLUENT
N. Abdul Aziz, M. Mohd Hanafiah, Universiti Kebangsaan Malaysia / Environmental Science
Exploring renewable energy sources is becoming increasingly important due to its low environmental impacts as compared to the consumption of non-renewable fossil fuel sources. Waste-derived biogas is one of the promising technologies that yields a renewable, sustainable, and green source of energy. In Malaysia, palm oil mill effluent (POME) can be suitable feedstock for biogas production due to its abundant and high potential in energy generation. However, a comprehensive assessment need to be conducted to ensure the sustainability of POME-based biogas production. This study was conducted to evaluate cradle-to-gate life cycle performance of POME-based biogas production associated with the production of biogas by the anaerobic digestion of POME. The functional unit was defined as 1 tonne of POME used for biogas production and the system boundaries covered the plantation-processing mill-biogas plants stage. The life cycle assessment (LCA) was performed using ReCiPe 2016 environmental impact method and SimaPro 8.4. The software. The present study demonstrates that the generation of electricity from biogas is advantageous comparing electricity production in conventional power plants. The results also able to identify hotspots in the life cycle of the biogas production where environmental performance of the system can be improved and environmental benefits can be achieved from the anaerobic digestion of POME with regard to the reduction of greenhouse gases emissions.

TU27
Challenges and open issues in assessing new technologies for circular economy solutions
P. Macioni, Ecoinnovazione srl / Sustainability Department; A. Zamagni,
Ecoinnovazione / LCA and Ecodesign Laboratory; D. Tonon, Ecoinnovazione srl Circular Economy has become a concept quite known also within the public domain. It is a catchy term that puts together two words easily understood by everybody with a positive meaning. Moreover, it can be easily translated into simple rules/guidelines to follow to claim an improvement of our economy and its relation with the environment, such as: recycle, avoid dangerous substances, extend the life of the products. However, the reality is more complex, and the effort to close loops, to reduce waste streams in other life cycles, does not come for free. For example, burden shifts from resource depletion to other environmental impacts are likely and common consequences. For this simple reason, life cycle assessment and life cycle sustainability analysis should be used to support the identification and understanding of the potential advantages of circular economy solutions, while the identification and management of the unavoidable trade-offs. In the case of innovative technologies developed to extract valuable substances from waste streams the complexities of the analysis are related to: scale-up from laboratory or pilot scale to full industrial scale; different possible industrial applications of the technology; a basket of diverse applications of the innovative semi-finished product/ingredient delivered by the new technology; diversity of the function of the technology; complex market of the substituted products, etc. This work presents and discusses how the above-mentioned challenges and open issues, with a focus on the diversity of the function of the technology, have been addressed in a specific case of an innovative technology to extract polyphenols from different waste streams. The presented example shows that the analysis can be rather complex due to the need of addressing different applications, identifying the benefits of such a solution, and carrying out different functions according to the selected perspective. The oral presentation will detail how the main difficulties have been considered and addressed, such as the of scale-up, complex market of substituted products, different geographical location of the technology implementation. One key aspect is that the adopted perspective directly influences the results in terms of environmental preference of the innovative technology, and as such, the benefits of circularity solutions needs to be properly addressed and quantified, and are not inherently beneficial.

TU238 Circular economy: what does restaurant food waste generation data and consumer say? R. Dagiliute, Vytautas Magnus University / Environmental Science Department; A. Musteikyté, Vytautas Magnus University Around 88 million t. of food is annually wasted in the European Union. According to FAO (2013), 31–39% of food is wasted at consumption level in developed regions. This wastage has an enormous negative impact on the global economy and food availability and has major environmental impacts. EU commissioner “Towards a circular economy: a zero-waste programme for Europe” (COM/2014/0398 final) aims to reduce by half food waste in EU by 2030. Roadmap to a Resource Efficient Europe (COM (2011) 571) aims to change consumption patterns and achieve 20% reduction in the food chain’s resource inputs and halved disposal of edible food waste in the EU by 2020. As study (2008) on British household data indicates, 61% of wasted food could be consumed if it would be better handled. Hence, changes in consumption patterns are in importance to reach those aims and reduce related impacts. This study analyses amounts of the food waste generated in a restaurant X (Vilnius, Lithuania) and explores consumers’ attitude towards this problem. Catering business was closely monitored in terms of customers' flows and food waste generated. To find out consumers’ opinion about the food waste in the restaurant we surveyed 174 people in total. Research results shown that during the six months 14744 kilograms of food was thrown away in a restaurant. Amount of food waste was linked to the total number of customers during the selected timeframe. Most of food was discharged in December, and in the spring quantities of food waste decreased mostly due to the seasonality. Weekend effect was also registered. Flour products composed the biggest share of all food waste. It was found that the restaurant consumers had low ecological consciousness - inadequate standpoint of consuming too much, poor knowledge about what impact food waste has on environment, recycling, and opportunities to waste less. 73% of those often eating at public caterers indicate often to leave some food uneaten. Only 5% always and 22% often ask to take-away left food. 43% of those surveyed are willing to participate in food waste programmes. Most of respondents were with higher education and higher incomes. Although respondents had no clue on their own negative impact to the environment, they all agree that much more needs to be done. Policies to encouraging food saving at home and public places should be promoted to deal with “food waste challenge” (2015).

TU239 Assessment of Carbon Footprint of a typical Spanish dietary pattern: The Atlantic diet X. Esteve Llorens, Universidade de Santiago de Compostela / Chemical Engineering; M. Moreira, G. Feijoo, Universidad de Santiago de Compostela / Chemical Engineering; J. Garrido, Universidad de Santiago de Compostela; S. González-García, Universidad de Santiago de Compostela CIF Q1518001A Chemical Engineering Access to adequate nutrition is a basic human need that depends on numerous social, political and economic factors. Similarly, food patterns affect not only to food consumption but also its production, which cause health, social and environmental impacts. In particular, food chains that support diets are linked to environmental issues such as greenhouse gas (GHG) emissions, fossil energy requirements and land use. According to Garnett (2011) and Irz et al. (2016), 15-30% of total GHG emissions in developed countries are derived from food production, distribution and consumption. Therefore, environmental pressures from food systems are on the top of the political agendas, and sustainable food production and dietary patterns are considered of major interest. Consumption patterns vary significantly across Europe. In the southern countries, healthier diets richer in fruits and vegetables have been identified. In this sense, the traditional Atlantic diet is a common dietary pattern in Northern Portugal and Galicia (Northwest of Spain), culturally and climatic similar areas. The Atlantic diet is characterised by an abundant consumption of vegetables, fish and meat, mainly local and fresh products (seasonal food), cooked to maintain its characteristic flavour and taste. For this reason, it has been become a worldwide reference for a healthy diet. The main objective of this study was to quantify the carbon footprint of the Atlantic diet using a simplified Life Cycle Assessment (LCA) approach due to the lack of detail certain stages of the life cycles of various foods. To do so, the production, transport and processing (when necessary) of the different food ingredients that constitute a typical daily menu was taken into consideration. According to the preliminary results, food production was the main responsible for contributions to the carbon footprint, mostly due to agricultural and livestock activities involved in the production of vegetables, fruit and meat. The findings from this study can be used as a first step to enhance and intensify determinants in the Atlantic diet. Moreover and in line with the literature (Pernollet et al., 2017), the use of a simplified LCA method reports accurate results at a lower demand of data collection than the full LCA. This research has been supported by a project granted by Xunta de Galicia (ED431F/2016/001). S.G-G. would like to express her gratitude to the Spanish Ministry of Economy and Competitiveness (RYC-2014-14984).

TU240 Assessing life-cycle impacts of the sharing economy: how to account for behavioural changes? N. A. Chatziantoniou, KU Leuven / Department of Materials Engineering; K. Van Acker, KU Leuven / Materials Engineering; J. Eyckmans, KU Leuven / Faculty of Economics and Business The sharing economy, facilitated by digital platforms, is expanding in to more and more areas of the economy and could help the transition to a more circular and sustainable economy. The a priori environmental benefits of sharing arise from the potential to use resources more efficiently and intensively. EU and the corresponding countries have initiated sharing programme for Europe as a way to “Towards a circular economy: a zero-waste programme for Europe” (COM/2014/0398 final) aims to reduce by half food waste in EU by 2030. Roadmap to a Resource Efficient Europe (COM (2011) 571) aims to change consumption patterns and achieve 20% reduction in the food chain’s resource inputs and halved disposal of edible food waste in the EU by 2020. As study (2008) on British household data indicates, 61% of wasted food could be consumed if it would be better handled. Hence, changes in consumption patterns are in importance to reach those aims and reduce related impacts. This study analyses amounts of the food waste generated in a restaurant X (Vilnius, Lithuania) and explores consumers’ attitude towards this problem. Catering business was closely monitored in terms of customers' flows and food waste generated. To find out consumers’ opinion about the food waste in the restaurant we surveyed 174 people in total. Research results shown that during the six months 14744 kilograms of food was thrown away in a restaurant. Amount of food waste was linked to the total number of customers during the selected timeframe. Most of food was discharged in December, and in the spring quantities of food waste decreased mostly due to the seasonality. Weekend effect was also registered. Flour products composed the biggest share of all food waste. It was found that the restaurant consumers had low ecological consciousness - inadequate standpoint of consuming too much, poor knowledge about what impact food waste has on environment, recycling, and opportunities to waste less. 73% of those often eating at public caterers indicate often to leave some food uneaten. Only 5% always and 22% often ask to take-away left food. 43% of those surveyed are willing to participate in food waste programmes. Most of respondents were with higher education and higher incomes. Although respondents had no clue on their own negative impact to the environment, they all agree that much more information on solving problems like this is needed. Therefore, policies to encouraging food saving at home and public places should be promoted to deal with “food waste challenge” (2015).

TU241 Effects of plant growth and organic carbon addition on DDE degradation in soils M. Cardoni, National Research Council of Italy / Water Research Institute; F. Mitton, University of Mar Del Plata; M. Di Lenola, National Research Council of Italy / Water Research Institute; L. Patrolecco, Water Research Institute-National Research Council / Water Research Institute; N. Adamello, F. Spathar, National Research Council of Italy / Water Research Institute; K. S. Miglioranza, University of Mar Del Plata / Laboratorio de Ecotoxicologia y Contaminacion Ambiental; Instituto de Investigaciones Marin as y Costeras; M. Gonzales, University of Mar Del Plata; P. Genni, National Research Council of Italy (CNR) / Water Research Institute; A. Bara Caracciolo, National Research Council / Water Research Institute Although the use of DDT was banned in numerous Countries several years ago, owing to its high lipophilicity and persistence, this pesticide and its metabolites (p’-DDE and p”-DDE) are frequently found in the environment. Plant-assisted bioremediation can be a promising clean-up technology to contaminated soil remediation; it relies on the synergistic action between plant rhizosphere and microorganisms to remove toxic substances. In this work, Solanum lycopersicum together with dissolved organic carbon were added to DDE-contaminated soil for bioremediation purposes in greenhouse microcosms. The experimental set was
performed to assess the effectiveness on DDE biodegradation of tomato plant presence with and without the addition of two different DOC (with different humic substance composition). The pots were filled with contaminated soil (1 ppm of DDE) in presence/absence of tomato plants and watered with different kinds of DOC solutions; control soils (with/without plant and/or DDE) were also implemented. The plots were sampled after 40 days from DDE exposure. The effect of the treatments on the bioremediation of DDE was expressed in terms of microbial abundance, viability, structure, dehydrogenase activity and DDE residual concentration. The results showed that the plant presence stimulated the overall soil microbial community activity but did not increase significantly the DDE biodegradation. The quality of the organic carbon in terms of fulvic and humic acids presence influenced differently both DDE degradation and microbial activity.

TU242 Soil microbial community associated to a poplar-assisted bioremediation study

A poplar-assisted bioremediation strategy has been applying for four years to a historically polychlorinated biphenyls (PCBs) contaminated area in Southern Italy using the Monviso poplar clone. This clone was effective in promoting both a general decrease in contaminant occurrence and an increase in microbial activity in the chronically polluted area a little more than one year after planting. In fact, the system based on the presence of poplar and plant treatments, biomass gasification is a very efficient process to produce clean energy and economically viable. At the same time, this technology can provide wood and other renewable resources.

Consequently, the switching of aerobic and anaerobic conditions in rhizosphere can be a promising strategy to promote both the degradation of high/low chlorinated PCB congeners. This study was a preparatory experiment for a field experiment of plant-assisted bioremediation.

TU243 Plant-assisted bioremediation to recover multi-contaminated areas and provide biomass for renewable energy production

Phytoextraction is gaining popularity as a sustainable solution to contaminated soil remediation. In particular, plant-assisted bioremediation exploits synergistic action between plant roots and natural microorganisms (bacteria and fungi) to remove, transform or stabilize toxic substances in soil, sediment or water. Such treatment can be effectively applied to contaminated areas. It is based on the use of suitable plant species, selected to stimulate the biodegradation activity of rhizosphere microorganisms (e.g. through the production of radical exudates or oxygen release). The plant-assisted bioremediation is an environmental recovery strategy for areas affected by widespread and multiple contamination, ecologically and economically viable. At the same time, this technology can provide wood biomass that can be efficiently treated to produce renewable energy. Among these treatments, biomass gasification is a very efficient process to produce clean energy in the form of a fuel gas (syngas). Among plant species poplar has good energy production potential, can grow in different environments and it is among the fastest growing trees. Furthermore, poplar demonstrated the capability to absorb organic contaminants (i.e. heavy metals) from the soil in which it is cultivated. For these reasons, the potential of poplar for synergizing, using biomass collected from a plant assisted bioremediation area located in a multi-contaminated soil in Southern Italy. The implementation of these technologies is line with the sustainability criteria of the Renewable Energy Directive (EC 2009) and with those of the “circular economy”, according to which by recovering energy from a material that would otherwise be a waste, taking care to separate any hazardous pollutants released during the process. An exhaustive Regulation, which establishes threshold limits of contaminants in the biomass and rules on how to manage it outside the remediation site, is necessary.

TU244 Microcosm experiment to assess the effectiveness of a Populus clone to enhance PCB biodegradation in a historically contaminated soil
L. Passatore, National Research Council / Institute of Agro-Environmental and Forest Biology (IBAF); A. Barra Caracciolo, National Research Council / Water Research Institute; M. Di Lenola, National Research Council of Italy / Water Research Institute; P. Genneri, National Research Council of Italy (CNR) / Water Research Institute; I. Nogues, National Research Council of Italy / Institute of Agro-Environmental and Forest Biology (IBAF); E. Guerriero, P. Benedetti, National Research Council / Institute of Atmospheric Pollution Research; A. Massacci, Italian National Research Council / IBAF.

Greenhouse experiments have been performed to test the capacity of the Populus clone (Populus Monviso) to grow on a PCB historically contaminated soil and to improve soil quality in terms of contaminant transformation and autochthonous microbial community abundance and activity. The experimental set-up consisted of pots filled with the contaminated soil and poplar cuttings, under the following conditions: microbiologically active soil (TMA), previously sterilized soil (TS), microbiologically active soil in hypoxia (TMAA). Moreover, non-plant soil was used as control. PCB concentrations in soil samples and plant roots were analysed 6 months and 12 months after the start of the experiments. At the same time plant growth, biomass production and plant stress indicators (i.e. chlorophyll content, leaf fluorescence, antioxidant in plant tissues) were investigated together with cell abundance, diversity and viability of soil microorganisms under the different growing conditions. The overall results showed the capability of the clone Monviso to transform and bioremediate PCBs in roots. The PCB transformations were initially higher in the microbiologically active soil; subsequently in line with a high microbial growth of the sterilized soil, the amount of indicator congeners found were similar between the two treatments. The anoxic treatment differed in terms of congeners detected, microbial community structure and activity and plant physiology stress indicators. However, the Monviso clone showed an unexpected capacity to produce biomass under flooding treatment.

In the last two decades bioremediation techniques have become ever more important as a sustainable alternative to traditional remediation techniques. In particular, there has been an increasing attention on rhizoremediation techniques, employing plant roots and their associated microorganisms to enhance the degradation of organic contaminants in soil. Many short-term laboratory/hydroponics experiments and long-term field trials have been conducted to evaluate the most suitable fertilizers and environmental conditions to stimulate and favour microbial activities in the degradation of Polychlorinated Biphenyls (PCBs). Recently, an attempt to extrapolate rhizoremediation half-lives (rhizo-HLs) for the ten PCB families from these studies has been made (Terzaghi et al., 2018) providing important data for multimedia fate models that aim to predict the time needed to achieve regulatory thresholds in a PCB contaminated site where rhizoremediation techniques are applied and therefore to draw up its remediation plan. However, many of the studies available in the literature (more than the 80%) were not correctly set up to allow the calculation of PCB rhizo-HLs and could not be considered. In particular the main pitfalls in the experimental design referred to the type of chemicals (single congeners vs. mixture), contamination (spiked vs. naturally present in the soil), plant species (natural vs. cultivar) and environmental conditions (e.g. plant growth, soil moisture, plant height). Consequently, the switching of aerobic and anaerobic conditions in rhizosphere can be a promising strategy to promote both the degradation of high/low chlorinated PCB congeners. This study was a preparatory experiment for a field experiment of plant-assisted bioremediation.

TU245 Are PCB half-lives obtained in rhizoremediation experiments reliable? Pitfalls in experimental design and suggested guidelines for conducting the experiments
E. Terzaghi, University of Insubria (Italy) / Department of Science and High Technology; E. Zanardini, C. Monosi, University of Insubria / Department of Chemistry Engineering Materials and Environment; S. Borin, University of Milan / DeFENS; F. Mapelli, University of Milan; L. Vergani, University of Milan / Department of Food, Environmental and Nutritional Sciences; A. Di Guardo, University of Insubria / Department of Science and High Technology.

Three treatments (poultry manure (PM), Nitrogen Phosphorus Potassium fertilizer (NPK), and a combination of both) were used for bioremediation of soil spiked with used motor oil to determine the potential of these treatments in enhancing biodegradation of used motor oil in soil. The degree of biodegradation of used motor oil was measured in the field experiment by performing gravimetric determination of the degree of biodegradation (

TU246 Effect of Organic and Inorganic Fertilizers on the Bioremediation of Used Motor Oil Polluted Soil
P. Ferdinando, U.E. Ezeji, Federal University of Technology Owerrri / Biotechnology

Three treatments (poultry manure (PM), Nitrogen Phosphorus Potassium fertilizer (NPK), and a combination of both) were used for bioremediation of soil spiked with used motor oil to determine the potential of these treatments in enhancing biodegradation of used motor oil in soil. The degree of biodegradation of the oil was
studied for a period of 4 weeks under laboratory conditions. Hydrocarban-utilizing bacteria counts were high in all the poultry manure-amended soil ranging between 9.0×10^3 and 30×10^5 CFU/g compared to unamended control soil throughout the 4 weeks of study. Oil-contaminated soil amended with a combination of poultry manure and NPK fertilizer showed the highest reduction in total petroleum hydrocarbon with loss of 80% in the 4th week compared to other treatments. The results obtained demonstrated the potential of the treatments for oil bioremediation in the order: Poultry Manure and NPK > Poultry Manure > NPK.

TU247

Soil pollution and physico-chemical properties steer the bacterial community structure in the uneven highly polluted SIN Brescia-Caffaro site.

F. Mapelli, University of Milan / DeFENS / Department of Food, Environmental and Nutritional Sciences; L. Vergani, University of Milan / DeFENS; E. Terzaghi, University of Insubria (Como) / Department of Science and High Technology, Como; G. Rasp, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; E. Zanardini, C. Morosini, University of Insubria / DSAT; A. Di Guardo, University of Insubria / Department of Science and High Technology, S. Barin, University of Milan / DeFENS.

Contaminants are strong ecological drivers steering the microbiome structure in polluted soils. Bioremediation relies on the residing microbial communities and their activity can be limited by spatial heterogeneity of microbial populations, contaminants and soil chemistry. Studies aimed at identifying the drivers of microbiome selection are therefore pivotal to develop in-situ bioremediation techniques. In this perspective, we studied the Soil Pollution Property Site SIN Brescia-Caffaro (Italy) offers a fascinating natural laboratory due to its extremely high, old, mixed and uneven soil contamination by metals and organic pollutants, in particular polychlorinated biphenyls (PCBs). Aim of our study was to evaluate the spatial correlations between environmental factors (pollutant fingerprints and soil physico-chemical properties) and the soil microbial community structure. More than 1,000 soil samples were collected in the SIN-Caffaro along a tridimensional geostatistically conceived grid, and were analyzed to estimate the soil hydrolytic activity, the physico-chemical features and the concentration of metals and 79 PCB congeners. A cultivation-independent approach led to unravel the phylogenetic structure of the residing bacterial communities. By means of statistical analyses, we showed that significantly different bacterial communities were selected in the investigated areas within the SIN Brescia-Caffaro. Spatial distribution of bacterial populations within each site was significantly correlated with physico-chemical soil parameters and pollutant concentrations. Soil physico-chemical properties were also significantly correlated to the hydrolytic activity of the soil microbiome, a relevant indicator of soil quality and pollutant availability. Biological activity related to organic matter degradation in the SIN-Caffaro soil was demonstrated in the soil properties and the contaminant profile in the SIN Brescia-Caffaro shaped the structure of the residing bacterial communities, leading to hypothesize that it drove the selection of populations able to degrade the contaminations. The detection in the SIN Brescia-Caffaro soils of the bph gene, coding for the biphenyl dioxygenase involved in the aerobic PCB degradation process, confirmed that they host an indigenous metabolic potential, possible future intervention interventions. This study also highlighted the prospect of exploiting spatial patterns of bacterial diversity as proxies for monitoring polluted sites.

TU248

Laboratory-scale assessment of bioremediation of hydrocarbon-contaminated soil.

F. Diana, University of Milano - Bicocca; T. Stella, University of Milano-Bicocca / DISAT; M. Daglio, University of Milano - Bicocca / Department of Earth and Environmental Sciences; F. Pittino, University of Milano Bicocca; R. Ferrari, A. Francioli, HPC Italia s.r.l.; A. Franzetti, University of Milano - Bicocca / Department of Earth and Environmental Sciences.

Recalcitrant hydrocarbons often persist in contaminated environments. Biological remediation strategies (bioremediation) are a widely used approach to remove hydrocarbons. This study focused on bioremediation of hydrocarbons contaminated soil from an industrial active site using biopiles. The site is contaminated by light and heavy hydrocarbons, the latter ones representing the most recalcitrant fraction. Biological bioremediation is the most appropriate solution for such highly degraded soils. The results demonstrated that the soil properties and the contaminant profile in the SIN Brescia-Caffaro shaped the structure of the residing bacterial communities, leading to hypothesize that it drove the selection of populations able to degrade the contaminations. In order to optimize this process, a lab-scale test was carried out and three different conditions were tested: natural attenuation (NA), addition of sulfathiazole (ST) to improve the soil structure and addition of compost as amendment (CO). Thirty-six bioreactors were set up (6 sampling points for each condition in duplicate) and incubated for 180 days. Air pumps were used to aseptically add air to bioreactors with the exception of NA ones. Laboratory analyses were performed on soil and soil gas samples at the beginning of the experiment and 6 samplings were carried out during the incubation period. Chemical analyses (GC-FID) of total petroleum hydrocarbons (TPH) were performed to evaluate the degradation rates and microbiological/molecular analyses (Total Bacterial Count, Most Probable Number-MPN, High-throughput sequencing of the 16S rRNA gene and quantitative PCR) to assess the growth of bacteria potentially involved in the degradation process. The highest degradation rate was observed in CO bioreactors (first-order rate constant K=0.180 d^-1) while lowest rates were observed in NA (K=0.004 d^-1) and SW (K=0.011 d^-1) in the first 60 days of incubation. However, a residual TPH concentration of >900 ppm was reached in all bioreactors after 180 days starting from an initial concentration of 2660 ppm. The microbiological characterization suggested a selection of the bacterial community according to the chemical results. In this respect, MNP results showed a significant increase in the number of oil-grown microorganisms in CO bioreactors. These data will be confirmed by qPCR of the catalytic gene alkB encoding for an enzyme potentially involved in the biodegradation of hydrocarbons (on-going analysis).

TU249

Influence of Surfactants and Mycobacterium vanbaalenii PYR-1 Bioaugmentation on 14C-Pyrene Mineralization and Microbial Community Structure in PAH-Contaminated Soils.

D.C. Wolf, University of California-Riverside / Environmental Toxicology; J. Gan, University of California, Riverside / Department of Environmental Sciences.

Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental contaminants that have potential mutagenic, carcinogenic, and teratogenic properties. Bioremediation has been recognized as a versatile approach to remediate PAH-contaminated soils. However, the biodegradability of PAHs is limited by their bioavailability to microorganisms in the soil pore water fraction. To expedite biodegradation, surfactants at the critical micelle concentration (CMC) has been added to enhance the bioavailability of PAHs. The aim of this work was to evaluate the effect of the surfactant and Brij-35 surfactant on the biodegradation of pyrene in contaminated soils. Biopiles will be built to treat the contaminated soil. Bioremediation could be the best solution to recover this area considering both the soil contamination and the cost of the remediation strategies.

TU250

Italian field results of Enforced Lecithin-based Substrate used as ERD treatment of Chlorinated Solvents in groundwater.

A. Leonbrunic, M. Mueller, PeroxyChim LCC; F. Morlacchi, Centro Assistenza Ecologica

ELS Microemulsion is a food-grade carbon that supports the treatment of a wide range of groundwater contaminants, including chlorinated solvents. ELS is the acronym for Enforced Lecithin Substrate, a technology designed to create reducing conditions and to promote enhanced reductive dechlorination (ERD) reactions. In general, organic carbon addition in a saturated zone is well-known to promote conventional enzymatic reductive dechlorination reactions. This happens because carbon in the subsurface will support the growth of indigenous microbes in the groundwater environment. As bacteria ferment the ELS, they release a variety of volatile fatty acids (VFAs) such as lactic, propionic and butyric, which diffuse from the site of fermentation into the groundwater plume and serve as electron donors for other bacteria, including dehalogenators. Lecithin itself is composed primarily of phospholipids, which have both hydrophilic and hydrophobic compounds. Further, phospholipids support degradation of chlorinated solvents in groundwater. As bacteria ferment the ELS, they release a variety of volatile fatty acids (VFAs) such as lactic, propionic and butyric, which diffuse from the site of fermentation into the groundwater plume and serve as electron donors for other bacteria, including dehalogenators. Lecithin itself is composed primarily of phospholipids, which have both hydrophilic and hydrophobic regions in their molecular structure. As a result, ELS tends to be stable emulsions, expectedly more stable than with only hydrophobic compounds. Further, phospholipids support remediation by providing essential nutrients (carbon, nitrogen, phosphorus) to bacteria. ELS Reagent was shown to effectively treat tetrachloroethylene (PCE) and trichloroethylene (TCE) in contaminated groundwater. The aim of this work was to evaluate the effect of the surfactant and Brij-35 surfactant on the biodegradation of pyrene in contaminated soils. Biopiles will be built to treat the contaminated soil. Bioremediation could be the best solution to recover this area considering both the soil contamination and the cost of the remediation strategies.
VOCs potentially migrating from beneath the facility. A total of 4000 kg of ELS concentrate was emulsified and injected under pressure through 51 injection wells in the swallow contaminated aquifer. Subsequent field monitoring showed PCE and TCE below detection limits at all wells after 6 months. A 99.8% reduction of PCE and TCE was observed in the source and plume areas adjacent to the reduction of the recognized contaminants, such as DCE or VC. Moreover, complete reductive dechlorination of 1,2-dichloroethane has also been observed in all the monitoring wells.

TU251 Cheese whey effects on microbial communities in contaminated groundwater of an urban area
D. Vlkova, Technical University of Liberec / Institute of Nanomaterials, Advanced Technologies and Innovation; I. Dolínavá, Regional Hospital in Liberec / Centre of Clinical Biochemistry; S. Wachávek, A. Sevců, Technical University of Liberec / Institute for Nanomaterials Advanced Technology and Innovation

Interestingly, Dehalococcoides mccartyi strain CDB1 and Dehalobacter strain 14DCB1 share a common substrate spectrum but yield different dehalogenation patterns, suggesting different sites of primary attack (selectively bound halogen vs. H) by the nucleophile cofactor (vitamin B12). The latter was unraveled through quantum chemical analyses of respective electronic structure characteristics. Building on these recent results, a perturbational approach is presented for dechlorinating halogenated organics by the molecular initiating event triggering the reductive dehalogenation. Application to 93 aryl halides covering chlorinated benzenes, phenols, anilines, biphenyls, dibenzo-p-dioxins, and brominated benzenes reveals that the lowest symmetry-coupling e* orbital located at the carbon-halogen bond mediates the dehalogenation step, and enables discriminating CDB1-active from non-active substrates.

To overcome the limits of the molecular initiating event triggering the reductive dehalogenation, an MO approach has been developed for a more detailed analysis of the molecular initiating event triggering the reductive dehalogenation. The authors acknowledge the assistance provided by the project No. TF02000064 supported by TACR.

TU252 The Influence of Nanoscale Zero-valent Iron (nZVI) in Combination with Carboxymethyl cellulose (CMC) on the Dehalorespiring Microflora
K. Markova, Technical University of Liberec / Institute for Nanomaterials, Advanced Technology and Innovation; D. Vlkova, Technical University of Liberec / Institute of Nanomaterials, Advanced Technologies and Innovation; I. Dolínová, Technical University of Liberec / Institute for Nanomaterials Advanced Technology and Innovation; J. Něsok, Technical University of Liberec

Application of different carbon sources (lactate, glucose, cheese whey and polyhydroxybutyrate) on the CE-contaminated groundwater was previously tested in the bench-scale studies and based on these experiments, cheese whey was chosen for the in situ application. The effect of three consecutive cheese whey applications (first was in October 2017) on indigenous microbes was described using qPCR Due to the techniques after sampling time the DNA extraction was performed using a FastDNA Spin Kit for Soil according to manufacturer’s protocol. Extracted DNA was quantified using Qubit 2.0 fluorometer. Isolated samples were tested using qPCR method. An universal marker, 16s rDNA gene (total bacteria marker) was used as a control. Other monitored specific markers were focused on presence of Dehalococcoides, Dehalobacter, Sulfurospirillum and vinyl chloride (VC) reductases vcrA and bvcA. In addition denitrifying bacteria were monitored by nirK marker and sulphate reducing bacteria by dsrA marker. All data are counted in relative values. Higher bacterial abundance was detected based on all tested markers after the first cheese whey application. This application will be repeated two more times. Generally, application was successful and bacterial biomass and specific markers for organohalide respiration increased and prevailed in higher concentrations. Moreover, higher bacterial abundance triggered efficient sequential dehalogenation of the CE contaminants. Specific markers are still being monitored in the treated groundwater and will be discussed together with physico-chemical results.

TU253 Mechanistic insight into microbial reductive dehalogenation
S. Zhang, E. Helmholdt Centre for Environmental Research / Department of Ecological Chemistry; G. Schüürmann, Helmholdt Centre for environmental research - UFZ / Department of Ecological Chemistry

Microbiologically mediated reductive dehalogenation provides a promising approach to remediate and detoxify halogenated aromatics. Despite extensive respective studies, the mechanistic understanding of the underlying chemical reactions is still limited. Interestingly, Dehalococcoides mccartyi strain CDB1 and Dehalobacter strain 14DCB1 share a common substrate spectrum but yield different dehalogenation patterns, suggesting different sites of primary attack (selectively bound halogen vs. H) by the nucleophile cofactor (vitamin B12). The latter was unraveled through quantum chemical analyses of respective electronic structure characteristics. Building on these recent results, a perturbational approach is presented for dechlorinating halogenated organics by the molecular initiating event triggering the reductive dehalogenation. Application to 93 aryl halides covering chlorinated benzenes, phenols, anilines, biphenyls, dibenzo-p-dioxins, and brominated benzenes reveals that the lowest symmetry-coupling e* orbital located at the carbon-halogen bond mediates the dehalogenation step, and enables discriminating CDB1-active from non-active substrates.

Per- and polyfluorinated alkyl substances (PFASs) have been extensively used for environmental remediation applications. However, the toxicity of these compounds and their potential health hazards have led to their restriction or prohibition. Despite the progress made in the development of alternative technologies, PFOS remediation of contaminated waters remains a challenge. This study investigated the possibility of using microbial biosorption for PFOS environmental elimination. Perfluorooctane sulfonate (PFOS) is highlighted as the most abundant PFAS reported to contaminate the environment, animals and humans. The most frequently applied method for PFOS remediation of water is by passing it through activated granular carbon filters. Currently, there are increasing efforts to develop novel, efficient, cost-effective and sustainable methods for PFOS remediation of contaminated waters. This study investigated the possibility of removing PFOS by microbial binding. We tested the binding capacity of live and dead Escherichia coli OP50 in different PFOS concentrations. The exposed bacterial pellets were subsequently analyzed for PFOS by UPLC-MS/MS. The dead bacteria were found to have high adsorption (286-3234 μg/g of bacterial pellet) whereas their reusability of 0.3-12% was noted (μg/g of bacterial pellet). Importantly, the data also revealed that dead bacteria have at least equal affinity for PFOS isomers as the linear compound; which defines the applicability of PFOS bioremediation with dead bacteria as a promising alternative approach. We propose that microbial binding of PFOS can be applied as a novel, less costly technique for PFOS environmental elimination.

TU254 Bacterial biosorption of PFOS from contaminated waters
M. Stylianou, Orebro University / The Life Science Centre-Biology; I. Ericson Jogsten, Orebro University / MTM Research centre; P. Olsson, Orebro University / The Life Science Center-Biology; J. Sass, Orebro University / SCHOOL OF SCIENCE AND TECHNOLOGY

Per- and polyfluorinated alkyl substances (PFASs) have been extensively used for environmental remediation applications. However, the toxicity of these compounds and their potential health hazards have led to their restriction or prohibition. Despite the progress made in the development of alternative technologies, PFOS remediation of contaminated waters remains a challenge. This study investigated the possibility of removing PFOS by microbial binding. We tested the binding capacity of live and dead Escherichia coli OP50 in different PFOS concentrations. The exposed bacterial pellets were subsequently analyzed for PFOS by UPLC-MS/MS. The dead bacteria were found to have high adsorption (286-3234 μg/g of bacterial pellet) whereas their reusability of 0.3-12% was noted (μg/g of bacterial pellet). Importantly, the data also revealed that dead bacteria have at least equal affinity for PFOS isomers as the linear compound; which defines the applicability of PFOS bioremediation with dead bacteria as a promising alternative approach. We propose that microbial binding of PFOS can be applied as a novel, less costly technique for PFOS environmental elimination.

TU255 Hexavalent chromium reduction in a bioelectrocatalytic microbial electrolysis cell
G. Beretta, Politecnico di Milano / Civil and Environmental Engineering; A. Mastorgio, E. Sezenna, S. Sabrina, Politecnico di Milano

Groundwater is the environmental matrix most frequently affected by anthropogenic hexavalent chromium contamination. Due to its cancerogenicity, Cr(VI) has to be removed, hopefully using environmental-friendly and economically sustainable remediation technologies. To overcome the limits of the currently applied bioremediation technologies, an alternative strategy is the use of BioElectrochemical Systems (BESs) to stimulate bioreduction of Cr(VI). BESs include a set of technologies based on biocatalytic reactors where an electrode (anode) can function as the final electron acceptor for the oxidation of organic compounds; then electrons flow through the circuit and reach the cathode that acts as the electron donor for the bioreduction of oxidized species. In the present study, we have assessed if Cr(VI) can act as an efficient terminal electron acceptor for an anaerobic biochalcite in a Microbial Electrolysis Cell (MEC). The cathode was first inserted into the cathodic compartment of a diaphragm-cell Microbial Fuel Cell, and inoculated with autotrophic cultur parasite originating from anaerobic digester sludge. After 30 days of acclimation, the electrode was transferred into the cathodic chamber to work at -300 mV (vs. SHE) as the biocathode in a Cr(VI)-reducing MEC. An
abiotic control and an open circuit (OC) control were also operated in parallel.
Hexavalent chromium dissolved concentration was analyzed at the initial, during
the experiment and final time by spectrophotometric method, while the dissolved
total chromium was analyzed by ICP-MS. During the whole test, the current
intensity was monitored. At the end of the experiment, the microbial
characterization of the communities enriched on the biocathode and in the cathodic
solution was performed by 16S rRNA gene sequencing. The acclimation phase in
the MFC allowed the formation of an electroactive biofilm on the electrode. A
decrease in Cr(VI) concentration was observed at the end of the tests, both in the
polarized reactor and in the OC reactor. However, the BES ensured higher removal
efficiency than the pure chemical process. In addition, higher current values were
measured in the BES compared to the abiotic control, thanks to the biofilm
interaction with the electrode. The results from microbial characterization showed
that the bacterial community on the surface of the electrode was affected by the
cathodic polarization, and it was different from the biomass on graphite in the open
circuit system.

hydrocarbons and sulfide removal from marine contaminated sediments. A reactor
(POL) was built by connecting a bioelectrochemical cell to three holders containing
artificially contaminated sediment. The anode (polarized at 0 mV vs Ag/AgCl ) was
made by a graphite plate and the cathode was made using a stainless steel mesh.
Weathered North Sea crude oil was used to contaminate the sediment. Artificial
marine water was continuously recirculated into the system (flow rate 0.69 L/day).
An abiotic control (ABI) and an open circuit control (OC, disconnected electrodes)
were also set up. Total petroleum hydrocarbons (TPH) in the sediment, sulfur
species, and current production were monitored over time. Samples of the sediment
and of the anodic biofilm were collected to characterize the microbial communities
by high-throughput sequencing of the 16S rRNA gene. TPH removal was observed
in all the tested conditions. Contaminants removal was linked to current production
up to around 5 mA (POL) and negligible current was observed in ABI. Sulfate
reduction was also observed indicating the involvement of the sulfur cycle in the
process. Members of the families Desulfuromonadaceae and Prolixibacteraceae
dominated the anodic community.

TU256
Enhancing Reductive Dechlorination Combined with In-Situ Chemical
Reduction for the Remediation of a Heavy Contaminated Chlorinated
Solvents Source Zone in South of Italy
f. arjmand, I. Bona, L. Moretti, M. Cremonesi, CH2M Hill
The present site comprises an urban site where a historical Chlorinated
Compounds-CHC (mostly PCE) contamination has been released in aquifer before
eighties, and characterized by a long-term monitoring activity. Contamination is
present in shallow aquifer and was higher than 10 mg/L. The efficiency of the
remediation is currently about 99.9%, removed more than 300 Kg PCE. The site
characterization integrated with a MIP investigation to identify the plume. The
plume has been addressed into four areas then a combination of In-Situ Enhanced
Reductive Dehalogenation and In-Situ Chemical Reduction was selected to secure
contaminant removal due to biodegradation, approaching the electron donors for
PCE. This combination allows to have a reducing ambient due to producing
hydrogen which helps groundwater to reach an anaerobic environment which is
favorable for the microorganisms to degrade the PCE into the
end product, ethylene. The first injection applied in a pilot scale (Phase1) to
calibrate the injection for the site conditions. Based on the successful results of this
phase, the full-scale planned for phase two and applied in two steps. First step
covered the northern part of the plume (area A) in the upgradient and main source
zone (area B) which is the most contaminated area. In Area B also the vadose zone
has been treated. After a year (step 2), the injection took place in area C near to the
site boundary and in area D downgradient of the site. Due to PCE bioremediation
we have production of daughter products to prevent the accumulation of these by
product an air sparging and soil vapor extraction plants have been installed in the
site boundary to remove them from the soil vapor and aquifer. During the ERD we
have observed methane production because of methanogenesis reaction, CH2M has
decided to install a biofiltration plant, to prevent any dangers for the residential
areas nearby. The challenge this complex geology has been solved by using fixed
injection points with non-return valves corresponding to the depth of treatment in
each aquifer. This allowed for accurate and tailored dosage application of the
product without any risk of cross-contamination. Due to the rapid effect of
injection, it has been possible to observe very good reduction rates within only few
months from the application. PCE, has already shown reduction of three orders of
magnitude and in some points, we reached the target, with daughter compounds
appearing without accumulation.

TU258
Freshwater sediment enrichments to improve MFCs performance for in situ
remediation application: a phylogenetic microbial characterization
C. Armato, University of Torino / Department of Public Health and Pediatrics; D.
Ahmed, Istituto Italiano di Tecnologia / Centre for Sustainable Future Technologies
(CSFT@PoliTo); D. Traversi, University of Torino / Department of Public Health
and Pediatrics; V. Margaria, M. Quaglio, Istituto Italiano di Tecnologia / Center for
Sustainable Futures@Polito; G. Gilli, University of Torino / Department of Public
Health and Pediatrics; G. Saracco, Istituto Italiano di Tecnologia / Centre for
Sustainable Future Technologies (CSFT@PoliTo); T. Schilirò, University of
Torino / Department of Public Health and Pediatrics
One of the possible application for Microbial Fuel Cell (MFCs) is the in situ
remediation of contaminated sites. MFCs operation links the removal of pollutants
from contaminated sites to the production of current by means of the activity of
electrochemically active microorganisms (EAMs), able to degrade substrate
producing a flow of electrons. EAMs have potential applications in bioenergy
production, green chemical synthesis, bioremediation, bio-corrosion mitigation,
and biosensor development. The aim of this work was to investigate the effect of
two enrichments, a general (Gen) and a ferric citrate (FeC) ones, to increase the
percentage of EAM in order to improve the MFCs performances. A freshwater
sediment (Fw) sample was chosen as inoculum source. The effect of the enrichment
procedures was compared in term of both electrochemical performance and
biological characterization. The microbial community was subjected to three
sequential enrichments and then used as inoculum for the MFCs. Anodic potential
and voltage were continuously monitored. DGGE, sequencing and rt-qPCR
techniques were used to investigate the EAM community. Moreover microbial
α-diversity was calculated. The enrichment effect was evaluated both for the
precultures and for the three components of MFCs (planktonic, biofilm and rod).
Results showed that the MFC inoculated by Gen enrichment preculture had better
performance than the FeC one (shorter start-up time, lower anode potential, higher
current and power density). The main source of variability resulted to be the kind of
enrichment, both in the preculture and in the MFCs. Proteobacteria, Bacteroidetes e
Firmcutes resulted as the main Phyla in our samples. Geobacteraceae spp. and
Pseudomonas spp. decreased more during the FeC enrichments and their DNA
concentration was higher in the Gen-MFCs and FeC-MFCs, respectively. Microbial
population enriched with FeC showed a lower Shannon diversity index, both in the
preculture and at the MFCs level (p< 0.05). Enrichment with FeC decrease the
relative abundance of EAM and the microbial diversity. Previous studies show the
need of a heterogeneous community dominated by EAM to improve the remove of
contaminants and to increase the performance of the MFCs. The present work
indicates that Gen enrichment promoting the development of a self-balancing
community seems to be a preferential approach to be implemented in in situ
application.

TU257
Bioelectrochemical sulfide scavenging from hydrocarbon contaminated
marine sediments
M. Daghio, University of Milano - Bicocca / Department of Earth and
Environmental Sciences; E. Vaiopoulou, Ghent University / Center for Microbial
Ecology and Technology (cmet); C. Perri, University of Milano-Bicocca /
Department of Earth and Environmental Sciences; M. Zoeter Vanpoucke, Ghent
University / Center for Microbial Ecology and Technology (cmet); A. Sherry,
Newcastle University / School of Civil Engineering & Geosciences; C. Cruz Viggi,
National Research Council / Water Research Institute (IRSA); I.M. Head,
Newcastle University / School of Civil Engineering & Geosciences; A. Franzetti,
University of Milano - Bicocca / Department of Earth and Environmental Sciences;
F. Aulenta, National Research Council / Water Research Institute (IRSA); K.
Rabaey, Ghent University / Center for Microbial Ecology and Technology (cmet)
Thermodynamically favorable electron acceptors (e.g. oxygen) are quickly
consumed in hydrocarbon contaminated marine sediments. In this environment the
biodegradation of contaminants often occurs via anaerobic pathways. Due to the
high abundance of sulfate in marine water, hydrocarbons are often degraded by
sulfate reduction and toxic sulfide is produced. Several studies have showed the
possibility to couple anaerobic hydrocarbons degradation to current production in
Bioelectrochemical Systems (BES), in which an electrode (anode) can be used as a
solid electron acceptor by several groups of microorganisms. Anodic sulfide
oxidation is another important process that can scavenge sulfide from the
environment through biological and abiotic processes. The aim of this work was to
assess if the bioelectrochemial stimulation is an effective strategy to promote both

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TU259
Integration of molecular and isotopic analyses to investigate the potential of
aerobic biodegradation at a site contaminated by Monochlorobenzene
I. Pietrini, Politecnico di Milano / DICA; F. de Ferra, G. Carpani, Research Center
for Non Conventional Energy - ENI; L. Zaninetta, Syndial / Environmental
Business Services; M. Marchesi, Politecnico di Milano; L. Alberti, Politecnico di
Milano / Department of Civil and Environmental Engineering; T. Stella, University
of Milano-Bicocca / DISAT; A. Franzetti, University of Milano - Bicocca /
Department of Earth and Environmental Sciences
Bacterial communities associated with contaminated sites represent a great
opportunity for environmental bioremediation considering that bacteria are able to
use a wide number of chemical compounds as a source of carbon and energy. The
use of an integrated approach based on different methodologies to gather more
information about site-specific potential for bioremediation is gaining a wider
acceptance from public authorities. The main objective of our work was to define
quantitative indicators to assess the intrinsic degradation potential of a
monochlorobenzene (MCB)-contaminated aquifer by the use of a “toolbox” based
on isotopic and molecular biology analyses. Microcosms with groundwater
collected from a MCB-contaminated site were set up under aerobic and anaerobic

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is the case of the anaerobic digestion (AD) process, through which, in the absence of oxygen, the complex organic matter is transformed into gaseous products, such as CH₄, H₂, and CO₂. Although the engineering and technological aspects of the AD have been thoroughly studied, the microbial community is still managed as a ‘black box’, since most of the AD plants lack microbiological planning and monitoring. On the other hand, interactions between the microbial components have an impact in the combined performance of the bioprocess as a whole. Disruptions in the AD process are often related to a poor understanding of the ecology of the microorganisms responsible for the associated biochemical reactions. In this work, insights about microbial community dynamics, investigated with innovative molecular techniques, are presented in order to improve the understanding of the linkages between natural and biotechnological ecosystems, and, by applying microbial ecology principles, improve the environmental engineering practices.

**TU260** Isotopic and Molecular Biology fingerprinting of a complex contaminated industrial area

T. Stella, University of Milano-Bicocca / DISAT; I. Pietrini, Policlinico di Milano; F. de Ferra, G. Carpani, Research Center for Non Conventional Energy - ENEI; M. Marchesi, Policlinico di Milano; L. Alberti, Politecnico di Milano / Department of Civil and Environmental Engineering; A. Franzetti, University of Milano - Bicocca / Department of Earth and Environmental Sciences

**TU262** Evaluation of bioremediation potential in groundwater using newly-developed software

M. Kwaśniewski, Technical University of Liberec / Institute for Nanomaterials Advanced Technology and Innovation; D. Vlkova, Technical University of Liberec / Institute of Nanomaterials, Advanced Technologies and Innovation; I. Dolinova, Technical University of Liberec / Institute for Nanomaterials Advanced Technology and Innovation; M. Marchesi, Policlinico di Milano

Bioremediation is one of economic and effective environmental techniques being applied for the removal of different contaminants from the groundwater. To achieve a complete overview on bioremediation processes, knowledge about molecular-genetic, physicochemical, and chemical characteristics of the groundwater as well as geological parameters of the site is needed. The aim of this work is, therefore, to develop a user-friendly software allowing assessment of bioremediation process of chlorinated ethenes, even to unprofessional users. The software enables an interpretation of input data, resulting in evaluation of the potential for natural bioremediation at the contaminated sites. Suitability of conditions for bioremediation is simultaneously evaluated in this software. Moreover, data from one sampling round are only used. To ensure widespread user availability, the program was created in Microsoft Excel. Actual data from the Nový Bydžov site were used to verify and demonstrate program’s functionality in this work.

**Anthropogenic and natural sources of environmental contaminants highlight the impacts of opposing and conflicting regulations (P)**

G. Pantano, T.C. Souza, P.S. Fadini, A.A. Mozeto, Federal University of Sao Carlos

**TU263** REMEDIATION OF AQUATIC ECOSYSTEMS: ADSORPTION OF PHOSPHORUS BY SAWDUST

F. Piscitelli, University of Bologna / Department of Chemistry; A. Pagani, University of Bologna / Department of Natural Sciences; E. Mantovani, University of Bologna / Department of Chemistry; G. Pantano, University of Sao Carlos / Department of Chemistry

**Introduction:** Despite the scenario of excess phosphorus in some aquatic environments, there has been concern with the deposition of phosphorus in wetland deposits, which can affect global food security. A possible solution to this contrast is the use of sawdust to remove the excess phosphorous from eutrophic systems, for further use as fertilizer. The aim of this work was to study the phosphorus adsorption using sawdust as organic adsorbent. Methods: This study was carried out with water and sediment samples from an eutrophic ecosystem, Barra Bonita reservoir, located in Barra Bonita city, Sao Paulo State, Brazil. The microcosm experiments were conducted in 5 L glass jars, that were filled with sediment and water from the reservoir. Among the 36 assembled microcosms, 18 were used as controls and 18 were used as treatment (with bags containing sawdust). The dissolved oxygen, iron, and orthophosphate were determined in interstitial water and water from the jar’s water column. Emerging contaminants and adsorbed phosphorus (P) were determined by mass spectrometry. Results: Dissolved oxygen values in the control microcosms were significantly higher (p < 0.05) in comparison to the treatment microcosms, as a consequence of the organic matter oxidation present inside the bags. The lowest concentration of Fe(II) found in the water column of the control microcosms causes the oxidation of the superficial sediment and this oxidized layer was responsible for the reduction of internal flow of P. In the interstitial water the Fe(II) concentration is much higher than in the water column due to the large amount of Fe present in the sediment. The concentration of orthophosphate in the water column varied during the experiment, in the treatment microcosm the decrease was indicative of phosphorus adsorption. It was observed that the adsorption of phosphorus on sawdust began after 57 days. The maximum adsorption was at 214 days (41.4 μg P g⁻¹ sawdust). The adsorption of ammonium and caffeine was not observed in sawdust. The concentrations of carbamazepine, diclofenac, paracetamol, ibuprofen, naproxen, propranolol, triclosan, estrone, 17-estradiol and 17-ethynlestradiol are lower than the limit of quantification (LOQ). Conclusion: Sawdust is considered a biosorbent, of easy management and cost, useful for the remediation of eutrophic environments. The possibility of phosphorus recovery is important to ensure water and global food security. Acknowledgments: FAPESP (2016/00490-6)

**TU261** Microbial ecology and ecosystem services: a key role for biotechnological applications

G. Lembo, ENEA CR / Department of Ecological and Biological Sciences; A. Signorni, ENEA-Italian Agency for New Technologies / Energy and Sustainable Development; V. Mazzurco Miritana, S. Rosa, A. Agostini, V. Pignatelli, University of Tuscia / Department of Ecological and Biological Sciences; G. Pantano, University of Sao Carlos / Department of Chemistry

**Results and discussion:**

Despite microorganisms are of micrometric size (1µm - 1mm), their activities impact on a planetary scale. They are ubiquitous and show remarkable metabolic versatility. They are able to thrive even in extreme environments. Very often, different strains of microorganisms perform metabolic activities in close relationship and/or have co-evolved mutual dependence for performing complex processes where members of the food chain depend on the previous ones for their substrates. Human kind is largely relying on microorganisms for its survival; they provide fundamental ecosystem services and perform complex biochemical activities to degrade residues and transform food. The scientific community is increasingly exploring the potentiality offered by functional microbial biodiversity to improve the human wellness and sustainability. Currently, a much interest is addressed towards biotechnological techniques that supply clean and affordable renewable energy sources exploiting the activities of microbial communities. This
TU264 Formation potential of trifluoroacetate and its estimation by means of the TOP assay

J. Janda, DVGW Water Technology Center / Analysis and Water Quality; K. Nödl, TZW DVGW-Technologiezentrum Wasser / Analysis and Water Quality department; F. Lange, DVGW Water Technology Center / Analysis and Water Quality; C. Zwirner, Environmental Analytical Chemistry, Center for Applied Geoscience, University of Tuebingen / Geosciences; H. Brauch, DVGW Water Technology Center / Analysis and Water Quality

Trifluoroacetic acid is the perfluorinated carboxylic acid with the shortest-possible chain length and thus a small, persistent molecule. Due to its high acidity (pK_a < 0.23) it occurs in its anionic form (trifluoroacetate, TFA) in the aquatic environment and is considered as highly mobile. Photochemical conversion of volatile refrigerants (e.g. 1,1,1,2-tetrafluoroethane) is the most frequently discussed anthropogenic source of TFA. However, its formation in the environment has also been shown for other substances containing trifluoromethyl moieties. Hence, a large number of active substances in modern crop protection agents, pharmaceuticals or industrial chemicals have to be regarded as potential TFA precursors. In the present study, the TFA formation potential of environmentally relevant substances was determined using the so-called total oxidizable precursor assay (TOP assay). In order to analyze the resulting concentrations of TFA, a method for quantitative extraction of the analyte from the highly alkaline and saline digestion solutions was developed. The subsequent measurement was performed using liquid chromatography coupled to tandem mass spectrometric detection (IC-MS/MS). The oxidative transformation of 10 precursors (pesticides: flufenacet, fluopicolide, fluopyram, flutamide and teflubenzuron; pharmaceuticals: fluoxetine and sitagliptin; industry chemicals: 4:2 fluoroanilines, 4-chloroaniline, N-methylpiperazine) were investigated. As expected, more TFA was formed after oxidation of the influents (up to 180 % increase relative to the concentrations without oxidative treatment) than of the effluents (between insignificant and 140 %). Interestingly, one WWTP exhibited a strong (biological) formation of TFA, which could be confirmed quantitatively using the TOP assay.

TU265 A Challenge for pesticide regulators: The example of 1,2,4-triazol in groundwater - Overview of regulatory strategies in Germany, Denmark and France

B. Smith, BVL / Department for plant protection products; W. Tüting, BVL; A. Ginsing, The Danish Environmental Protection Agency / Pesticides and Genetic toxicology, A. Boivin, ANSES; A. Gathmann, BVL / Department for plant protection products

The substance 1,2,4-triazol is a known metabolite of several fungicidal active substances used in plant protection products. Modelled groundwater concentrations of pesticides used for the active substance are below the limit value of 0.1 µg/L. In plant protection regulation, this limit value has to be applied for 1,2,4-triazol due its toxicological relevance according to the regulation (EC) 1107/2009. Exceedance of this trigger has been questioned considering that several fungicidal active substances forming 1,2,4-triazol may be applied consecutively. In addition, plant protection products are not the single source of 1,2,4-triazol. It can also originate from other sources, for example, insect inhibition uses as additive to fertilizers, or even be formed naturally in forest soils. Consequently leaching of 1,2,4-triazol from these different sources might lead to exceedance of the limit value for groundwater in agricultural catchments. Therefore, the competent authorities of Germany, Denmark and France have initiated monitoring programs and incidence reporting. If entries above 0.1 µg/L in groundwater are found and entry via pesticide application is considered likely, authorities may have to decide on further risk management actions. Possible mitigation measures are discussed and the difficulties in dealing with different sources and regulatory frameworks are highlighted.

TU266 PPPs on the basis of natural compounds: nature challenges analytics

M. Andre, F. Stahl, C. Jansen, SGS Institut Fresenius GmbH

For many plant protection products (PPP) using natural compounds as an active ingredient, considerable background levels are frequently observed in untreated control material. These contaminations originate from both, natural and anthropogenic sources. Applying the methods described in the literature for the determination and residue analysis more challenging. There are different routes for natural background concentrations resulting from natural sources as amongst which are: physicochemical degradation from higher compounds (e.g. degradation of triglycerides to fatty acids), microbiological activity or the use of a plant product as active ingredients (e.g. rapeseed oil). Besides the natural occurrence of the active ingredient or parts of it, anthropogenic routes of contaminations are also diverse: some active ingredients of PPPs were used in industrial production processes (e.g. short-chained fatty acids as softener for plastic materials), other compounds are incorporated in materials used for solvent production. Both may lead to high background levels. Both routes, the anthropogenic as well as the natural, can lead to background level contaminations of the active ingredients, making it hard or in some cases impossible to find contaminant-free control material and/or to determine these active ingredients at low concentration levels. Furthermore, natural compounds used as active ingredients in PPPs or their derivatives are of low molecular weight and thus leading to fragments < 100 Da in LC-MS/MS analysis. These are more difficult to analyse as the signals of these mass transitions are often disturbed.

Persistence & Biodegradation Assessment (P)

TU267 Implication of microbial adaptation for the persistency of emerging pollutants

B. A. Poursat, University of Amsterdam / IBED Institute / Institut for biodiversity and ecosystem dynamics; M. Braster, VU University Amsterdam; R. Helmus, University of Amsterdam / IBED; R. J. van Spanning, VU University Amsterdam; P. de Voogt, University of Amsterdam / IBED; J. Parsons, University of Amsterdam / IBED-ELI

Regulatory determination of the persistency of organic chemicals is mostly done using OECD ready biodegradability tests (RBTs). RBTs, however, suffer from several problems that lead to a high variability of the results and, hence, to difficulties in their interpretation. The origin and history of the inocula is one of the major causes of that variability. Nowadays, it is evident that results of RBTs change over time as microbial populations apparently adapt within years to metabolise previously persistent chemicals. Several studies also show an improvement of the biodegradation rates even after a short period of pre-exposure to the tested chemical. As such, there is a need to assess the influence of this process on RBTs. We, therefore, used chemostat systems to expose activated sludge microbial communities to 4 different chemicals, 4-2 fluoroanilines, 4-chloroaniline, N-methylpiperazine and metoflurone. Two of these chemicals are considered emerging contaminants and are persistent according to RBTs. The biodegradation capacity of the activated sludge and of the exposed inocula was assessed in batch culture using the OECD 310 guideline for testing of chemicals. Different phases of biodegradation were measured following CO_2-production (OECD 310) and the compound and product concentration by LC-MS/MS. Community changes in the chemostats were determined by 16s RNA sequencing. The results of these experiments show enhanced biodegradation capacity for N-methylpiperazine after pre-exposure to this molecule. Moreover, microbial communities exposed to metoflurone were able to degrade this molecule and its known persistent transformation product, guanylucrea, which is considered as persistent in fresh water. These preliminary results show that microbial communities can adapt to degrade a molecule that was initially persistent. These results are a first step to understand adaptation mechanisms and their implication for the persistency of organic compounds of emerging concern. This project aims at correlating microbial adaptation and biodegradation performance in time. The ultimate aim is to design more robust and realistic RBTs adapted inocula.

TU268 Prioritization of organic compounds based on their persistency in dissolved phase

L. Fuster, EPOC, University of Bordeuax / EPOC UMR 5805; M. Dèver, Université of Bordeaux / EPOC UMR 5805; M. Le Menach, UMR CNRPS EPOC Universite Bordeaux / EPOC UMR 5805; P. Mazellier, University of Bordeaux / EPOC UMR 5805; H. Budzinski, University of Bordeaux.

When considering the large number of chemicals potentially present in the environment, the scientific community seeks to establish a pertinent list of priority compounds. Assessing the persistency of chemicals such as pharmaceuticals or polar pesticides represents a need in order to realize a better prioritization of compounds of concern. Persistency in dissolved phase is widely dependent on intrinsic properties of compounds but also on environmental conditions such as temperature, salinity, or presence of microorganisms. Estuaries are characterized by gradient and high variability of salinity and suspended solids (SS). The environmental risk assessment may need to be adapted to dynamic conditions such as those prevailing in transitional areas. This study focuses on the persistency of polar pesticides and pharmaceuticals into turbidity maximum zone of the macrotidal Seine estuary. Laboratory batch experiments simulating mixing conditions of the discharge of wastewater into estuarine water were performed. The influence of SS concentration, salinity and abiotic control was assessed on a selection of 60 polar pesticides and 51 pharmaceuticals. In order to compare relative compound persistency in dissolved phase, a persistency index based on the half-lives of the compounds was calculated. Briefly, marks depend on half-life values of each condition, and the average mark gives the persistency index. Risk quotient is calculated with measured environmental concentrations of each compound in the Seine estuary. Of the 111 monitored compounds, 33 were quantified at the initial time. Only 3 exhibited a persistent behavior (e.g. atrazine) while biotic degradation was shown to be the main attenuation process for 15 molecules (e.g. diuron). Degradation was enhanced by increasing concentrations of suspended solids. Because half-lives of compounds presented important variations between all experimental conditions, valuable prioritization was complex to achieve in such conditions and consequently in transitional zones. A persistence
index and measured concentration in the Seine estuary were used together and allowed a categorization of compounds into 4 levels of environmental concern. Moreover, non-targeted analysis highlighted the formation of 794 compounds during 21 days of incubation, in high concentration level of SS condition. In order to improve risk assessment, formation of transformation products should have to be considered and included in prioritization schemes.

TU269
OECD 308 tests to explore differences in persistence of pharmaceuticals and microbial diversity between two rivers
C. Coll Mørg, Stockholm University / Environmental Sciences and Analytical Chemistry; Z. Li, Stockholm University / ACES; R. Bier, S. Langenheder, Uppsala University / Department of Ecology and Genetics/Limnology; A. Soheki, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES
Persistent pharmaceuticals in aquatic ecosystems are of particular societal concern and the OECD 308 guideline is often used to obtain the biodegradation half-lives required for risk assessment. The environmental relevance of OECD 308 has been criticized in recent years, mentioning the difficulty to interpret multiphasic processes (biotic and abiotic) and the lack of compartment-specific half-lives for water or sediment as an outcome. In particular, biodegradation processes in the sediment can vary according to the microbial communities, which may be impacted by the settings chosen for the test (i.e. sediment-water ratio, aerobic-anerobic conditions and initial concentration levels). In this study, we have investigated the differences in biodegradation of a mixture of 9 pharmaceuticals (acetaminophen, caffeine, carbamazepine, diclofenac, fluconazole, metformin, oxazepam, tramadol, and venlafaxine) using water and sediment collected from rivers Fyris and Grindlach, before and after the discharge of a wastewater treatment plant (WWTP). Bottle incubations were set following the OECD 308 guideline, spiked with pharmaceuticals and incubated for 40 days at 16°C in the dark with daily aeration. Water samples were taken at 10 time points and analyzed in UHPLC-MS/MS. The microbial community composition in the sediment was analyzed with Illumina sequencing of bacterial 16S rRNA to provide more insight into the biodegradation potential in the different treatments. The dissipation half-lives obtained for diclofenac, oxazepam, tramadol, and venlafaxine are significantly different (p < 0.001) between rivers and between locations. Additionally, the half-lives of non-stereiles are significantly shorter than sterile (p < 0.01) for all compounds except carbamazepine, indicating that dissipation reflects a combination of biodegradation and sorption mechanisms. Furthermore, compound concentrations remained constant in river water treatments, with only caffeine and acetaminophen showing signs of degradation. Dissipation of pharmaceuticals in the sediment was dependent on the kind of compounds and sorption cannot be completely excluded, the experiment results indicate that the biotic processes could be divergent between rivers, but also between sediments taken up- and downstream the WWTP. An analysis of the microbial diversity in sediment and water of each river will complement the differences in dissipation rates observed for the treatments.

TU270
Compartment-Specific Screening Tools - Development and Application to Assess Potential Persistence of Organic Compounds in Water, Sediment and Soil
T. Jünker, ECT Oekotoxikologische GmbH; A. Coors, ECT Oekotoxikologische GmbH; G. Staußmair, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry
The persistence assessment under REACH ideally relies on compartment-specific degradation half-lives that are generally derived from aerobic laboratory simulation studies for surface, aquatic sediments or soil. Albeit these data are given top priority, they are not available for most of the compounds since simulation tests are time-consuming and expensive, and they are required only for compounds with a production volume of 100 or more tons per year. Thus, screening information (e.g. results from ready biodegradability tests (RBTs) or quantitative structure-activity relationship (QSAR) models) are used in the absence of simulation test data to decide whether a substance is considered as “not persistent” or “potentially persistent” according to the screening criteria. However, RBTs only look at the water compartment while the QSAR models were only developed based on qualitative experimental biodegradation data related to water-only test systems. Therefore, half-lives for soil and sediment are calculated by multiplying the half-life in water by constant factors. However, this extrapolation is questionable due to different conditions in the compartments, which might affect biodegradation in connection with the physico-chemical properties of the compounds. Consequently, there is a lack of experimental quantitative biodegradation data for soil and sediment at the screening test level. In the present work compartment-specific screening tools for water-sediment (Water-Sediment Screening Tool, WSST) and soil (Soil Screening Tool, SST) were developed based on the existing MITI test system (OECD TG 301C). The test systems MITI, WSST and SST were applied to determine degradation data for a set of fifteen test compounds. The results demonstrate that the WSST and the SST are suitable to determine sound and reliable biodegradation data including biodegradation kinetics for compounds on the screening test level. Furthermore, the results were used within the scope of a Compartment-Specific Persistence Screening (CSPS). The results of the CSPS were in good agreement with the REACH standard persistence screening, resulting in slightly more conservative but reasonable results. Thus, the data can be applied to identify potentially persistent compounds in the regulatory context. Beyond that, the results can be used as input parameters for multimedia fate models to assess the environmental fate of the compound, e.g. overall persistence (P₅₀).

TU271
Persistence assessment of pesticides in Denmark
A. Ginsing, The Danish Environmental Protection Agency / Pesticides and Gentotechnology; A. Aagaard, S. Marcher, The Danish Environmental Protection Agency / Pesticides and Biocides; V. Møller, The Danish Environmental Protection Agency
Persistent active substances can affect the environment over long periods of time, as such substances can be distributed and accumulated within and outside the areas where they are used. Persistent substances constitute a long-term and difficult-to-quantify risk of spreading in the environment and affect organisms. Persistent substances can also cause effects on and lead to residues in subsequent crops. This also applies to the metabolites of an active substance. Therefore active substances with a DT50 above 180 days cannot be approved in Denmark. The persistence evaluation is based on an assessment of available reliable half-lives from both laboratory and field studies. All half-lives should be normalised to 20°C and pH 2. Assessment of persistency should not be based on average or percentiles of the data. Instead data are assessed by considering the soil types used and focusing on soil types representative for Danish conditions. If in general these soils have a DT50 above 180 days, products with such active substances cannot be approved for outdoor uses in Denmark. If only some of the soil DT50 values are above 180 days, an ad hoc assessment is performed to decide if these findings constitute the major part of data and if it is likely that DT50 for Danish soils is above 180 days under field conditions relevant to the intended use. The persistency evaluation should be performed for both the active substance and metabolites. However, metabolites which fulfill certain criteria are considered to be of no concern regarding persistence.

TU272
Influence of Winter Conditions on Fungicide Persistence in North American Golf Course Turfgrass
P. Koch, University of Wisconsin - Madison / Molecular and Environmental Toxicology Center
Fungicides are routinely applied to golf course turfgrass prior to winter in temperate climates around the world to protect the plants against psylliphorous plant pathogenic fungi. The persistence of these fungicides in the various environmental conditions present during winter is poorly understood despite important implications for human and environmental health as well as disease control on the turf. A 3-year field study was initiated at the University of Wisconsin - Madison (Wisconsin, USA) in 2015 to determine which environmental conditions most influenced the persistence of the fungicides propiconazole and chlorothalonil. Foliar concentration of both fungicides was measured using a chromatography-mass spectrometry, and a bioassay was conducted in a controlled environment chamber using the psylliphorous plant pathogenic fungus Microdochium nivale to determine the date when disease protection was lost. Fungicides were applied once on 20 Nov 2015 and again on 5 Dec 2016 and 10-cm diameter turfgrass cores were collected biweekly from the experimental area throughout winter. Both winters experienced above-average temperatures in December with frequent rainfall events, and the concentrations of both fungicides in the turfgrass leaf tissue fell dramatically within the first 28 days after application. In addition, a corresponding increase in M. nivale-disease symptoms in the controlled environment chamber was observed as fungicide concentration decreased. These results suggest that fungicides do not persist in winter conditions following rainfall events, though it remains unclear whether they persist for prolonged periods of time on frozen turf and under prolonged snow cover.

TU273
Biodegradability of novel graft copolymer with levan and polystyrene
B. Loncarević, Institute of Chemistry, Technology and Metallurgy, University of Belgrade / Department for Chemistry; M. Lješević, Institute of Chemistry, Technology and Metallurgy, University of Belgrade / Department for Chemistry; V. Miočić, Institute of Chemistry, Technology and Metallurgy, University of Belgrade / Department of Environmental Chemistry
The significant increase in plastics productions caused waste management problems which is particularly relevant for polystyrene plastic as the most dominant packaging material. Therefore, investigations of new biodegradable polymers are increasing. Graft copolymerization is important technique for physical and chemical modification of polymers. The microbial levan is biocompatible, biodegradable, renewable and eco-friendly fructose based polymer. It can be produced from sucrose by wide range of microorganisms using levascunchase enzyme. In the present study graft copolymer with microbial levan and polystyrene was synthesized, characterized and its biodegradable potential was investigated.
Levan was isolated after fermentation of *Bacillus licheniformis* strain. Syntheses of copolymer were performed by the free radical reaction using potassium persulfate as initiator. Verification of the synthesis was recorded by $^{13}$C NMR Bruker AVANCE III 500 spectrometer. Biodegradation potential in aerobic conditions of obtained copolymer was investigated using Micro-Oxymax respirometer (Columbus Instruments, Ohio). O$_2$ consumption of samples mixed with soil was measured in period of 28 days. The $^{13}$C NMR spectrum of copolymer showed the presence of monosaccharide units and concentrations of O$_2$ by respirometer in copolymer sample (705.0 L) compared to control (350.9 L) and polystyrene (499.5 L) after 673 h. The formation of levan and polystyrene graft copolymer was confirmed by $^{13}$C NMR analysis. Results after 28 days in aerobic biodegradation in soil shows that obtained novel copolymer has biodegradation potential, however additional tests for biodegradation are needed.

**TU274**

**Aerobic degradation of styrenated phenol in soil: influence of the temperature and of the characteristics of the soils**

M. Fiocchi, SOLVAY / HSE - PRA PS; P. Chagnon, SOLVAY / Research and Innovation.

The persistence of chemicals is assessed through their kinetic degradation in the environment. Several simulation tests are available to evaluate the half-life of the chemicals in different environmental compartments. The half-life is then compared to the Annex XIII criteria of REACH to decide if the substance is be considered as Persistent (P) or very Persistent (vP). Nevertheless, the interpretation of those tests is complex. Degradation study [14C]-2,4-TDA was studied through aerobic soil despite a standardization of the methods. In the present project, the rate and route of transformation of a styrenated phenol compound was investigated in four different soils and at two temperatures: 12°C and 20°C under aerobic conditions. Statistical analysis is performed to assess the influence of the temperature on several endpoints: mineralization rate of the parent compound, kinetic of degradation of the parent compound and of the main metabolites, formation of non-extractable residues. In addition, the influence of the characteristics of the soil is assessed to evaluate the representativeness of those tests for the evaluation of the actual fate and behavior of such chemical in the environment.

**TU275**

**Comparison of kinetics and products of degradation determined for the toluenediamine substances in the OECD-standardized ready biodegradability and sediment simulation tests**

C.R. Boegi, BASF SE / FEPA; C. Gaertner, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; H. Schwarz, BASF SE / RB/TC; R.J. West, International Isocyanates Institute, Inc. / Toxicology and Environmental Research Consulting

The OECD ready biodegradability tests (RBT) are designed to approximate the rate/extent to which substances are degraded in the environment, such as is more precisely measured in the OECD simulation tests. This work compares results obtained from both test types for degradation of the toluenediamine (TDA) substances. Degradation study [14C]-2,4- and 2,6-TDA was studied in duration despite a standardization of the methods. In the present project, the rate and route of transformation of a styrenated phenol compound was investigated in four different soils and at two temperatures: 12°C and 20°C under aerobic conditions. Statistical analysis is performed to assess the influence of the temperature on several endpoints: mineralization rate of the parent compound, kinetic of degradation of the parent compound and of the main metabolites, formation of non-extractable residues. In addition, the influence of the characteristics of the soil is assessed to evaluate the representativeness of those tests for the evaluation of the actual fate and behavior of such chemical in the environment.

**TU276**

**Evidence for Anaerobic Microbiodegradation of PCBs and PBDEs in Sediment cores from an e-Waste Site, South China**

B. Mai, Guangzhou Institute of Geochemistry; C. Huang, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences; Y. Zeng, Guangzhou Institute of Geochemistry

Biodegradation of polychlorinated biphenyls (PCBs) and polychlorinated diphenyl ethers (PBDEs) is an important transformation and detoxification route in the environment. To better understand the in-situ microbial degradation of PCB and PBDE in anaerobic sediment, three sediment cores from an e-waste dismantling site, South China, were sampled (named #1, #2, and #3, respectively). Post-extraction factorization model (PMF), compound specific isotope analysis (CSIA), and microorganism analysis were used to trace the in-situ biodegradation of these pollutants. High levels of PCB (44-67800ng/g, dw) and PBDE (62-792000ng/g, dw) were found in all the samples and the concentrations were general increased from bottom to the top layers. PMF analysis indicated that the technical mixtures are the dominant PCB and PBDE input and dehalogenation takes place in the sediment, especially for PBDEs. This conclusion was supported by the microorganism analysis, substantial Dehalococci were found in the sediment cores. The range of the relative abundance of Dehalococcoidetes for three sediment cores (#1, #2 and #3) were 1.50-90.01%, 1.47-52.4%, and 0.20-25.5%, respectively, which were significantly correlated with the ratios of factor 2 (biodegradation source) to PBDEs (with the p values of 0.02, 0.05 and 0.01, respectively). As for CSIA analysis, only the stable carbon ratios ($^{13}$C) of BDE 28, BDE47, BDE85, and BDE99 in the top 20cm of the #3 sediment cores were obtained. An increase in the $^{13}$C values for BDE 28 and a slightly decrease in the $^{13}$C values for BDE 85 were found with the increase of the depth sediment cores, indicating a potential biotransformation of these compounds in the cores. No significant differences in the $^{13}$C values for BDE 47 and BDE 99 were observed in the sediment cores, possibly due to the complicated fate of these compounds, such as BDE47 and BDE99 being both reactants and products during the debromination processes.

**TU277**

**Transformation and degradation mechanisms of flame retardant triphenyl phosphate in aquatic environment**

Y. Choi, Gwangju Institute of Science and Technology; S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering

Organophosphate flame retardants (OPFRs) in aquatic environment are concerned because they are latest alternatives chemicals of brominated flame retardants. Among OPFRs, triphenyl phosphate (TPHP) shows high consumption volumes, as well as high concentration in water. TPHP caused toxic effects especially in aquatic organisms but research of biotransformation products is insufficient. Kinetic studies of TPHP and transformation products are important to understand the effects on environmental organisms. To identify the biotransformation products of TPHP, *Daphnia magna* was used due to standard test species in aquatic environment. TPHP was exposed to individual *daphnia magna* and each sample was separated by biota and remaining medium. *Daphnia magna* were homogenized and remaining medium were extracted with solid phase extraction. Samples were analyzed using liquid chromatography–tandem mass spectrometry (LC/ESI-MS/MS) for quantitation and ultra-high-performance liquid chromatography-electrospray high-resolution tandem mass spectrometry (UHPLC-HRMS/MS) for qualification. Two major biotransformation products were detected in the study based on phase I & II biotransformation mechanisms. Diphenyl phosphate (DPPH), product of phase I reaction, was identified for biotransformation products both biota and medium. Among phase II reaction, sulfonyl triphenyl phosphate was verified; intermediate metabolites were not significantly detected due to brief reaction times. Parent compound (TPHP) and hydrolysis products (DPPH) were calculated by degradation ratios relative to control. Significant tendency were observed between TPHP and DPPH; as TPHP showed decreased, degradation product (DPPH) ratios increased. In conclusion, hydrolysis and sulfation were major mechanisms for biotransformation products of TPHP in environment. As a result, the risk to aqueous organisms must be estimated in order to develop regulations for organophosphate flame retardants in aquatic system.

**TU278**

**Photolytic and biological degradation of silicon organic compounds**

E. Feng, Leuphana University Lueneburg; O. Otsoneva, Leuphana University of Lueneburg / Institute for Sustainable and Environmental Chemistry; N. Mitzel, University Bielefeld / Inorganic and Structural Chemistry; K. Kuemerer, Leuphana University Lueneburg / Institute of Sustainable and Environmental Chemistry

This study provides new data on the degradability and persistence of a selected group of silicon organic compounds with the aim to identify the most suitable approach for the synthesis of new and potentially biodegradable compounds. Several new silicon organic compounds were synthesized by the free radical reaction using potassium persulfate as initiator. Verification of the synthesis was recorded by $^{13}$C NMR. Degradation study [14C]-2,4- and 2,6-TDA was studied in duration despite a standardization of the methods. In the present project, the rate and route of transformation of a styrenated phenol compound was investigated in four different soils and at two temperatures: 12°C and 20°C under aerobic conditions. Statistical analysis is performed to assess the influence of the temperature on several endpoints: mineralization rate of the parent compound, kinetic of degradation of the parent compound and of the main metabolites, formation of non-extractable residues. In addition, the influence of the characteristics of the soil is assessed to evaluate the representativeness of those tests for the evaluation of the actual fate and behavior of such chemical in the environment.
photolytic and biological degradation of these substances in aqueous solutions. Each compound was irradiated with artificial sunlight (xenon lamp, 300–800 nm, SUN-test CPS+). During the irradiation time of 8 hours, samples were taken every two hours and analysed directly with HPLC-UV/vis. An adapted closed bottle test (OECD 301 D) was used to investigate ready biodegradability. The degradation rate was determined by measuring the depletion of diluted oxygen during a period of 28 days of exposure to light at a constant degree. After 6 hours, 99% of the substance p-MeNC6H4Me3 was primarily eliminated. During the test, generation of more polar transformation products was observed. The other substances were eliminated between 15 and 65% with treatment of sunlight during a time period of 8 hours. No ready biodegradability could be observed for these five substances. The results from the biodegradation test are in agreement with the literature and our own database on siloxanes. Increased water solubility of the newly synthesised silicon organic compounds did not result in an increased biodegradability in water.

TU279 Biodegradation of adsorbed oil pollutants: Research on a model system

Microbial degradation (biodegradation) is an important mechanism for removal of chemicals and incubated in the laboratory. However, these experimental conditions are relevant to semi-solid phase and once this change is achieved, the removal of the oil by removal of the absorbent structure then becomes much easier. At this stage, pollutants are separated and concentrated, unlike the environment conditions where pollutants could spread to very low concentration when it is challenging for applying bioremediation techniques. In this study we tested adsorption and degradation of crude oil, diesel oil and mazut as model substrates. Two types of natural sorbents were used: organozeolite and bentonite. Petroleum pollutants sorption was investigated in the batch tank. Sorption was conducted with sorbents (1 g/100 mL) placed in Erlenmeyer flask (500 ml) with 100.0 mL of tap water and oil pollutant (0.6 ml). Sample was then shaken in laboratory shaker for 24 h at 20 °C. Supernatants and sorbents were separated by decantation. Biodegradation ability of adsorbed pollutants has been tested by microorganisms isolated from oil contaminated site, and O2 consumption and CO2 production was measured in period of 5 days by Micro-Oxymax respirometer. Adsorbed total petroleum hydrocarbons were determined after adsorption and respiration experiments by GC and gravimetric analysis. Obtained results showed highest biodegradation potential by bentonite/diesel (BED) model and lowest biodegradation potential with organozeolite/diesel model, with cells concentration of 80911.53 μl and 5834.53 μl of O2 within 115 hours, respectively. The production of CO2 by cells in BED model was more than twofold higher than by OZM model. As well, BED model obtained highest TPH decomposition at the end of experiments. This results indicate that bioremediation process can be successfully used on adsorbed pollutants, where added value is recycling of sorbent material, but further investigation are needed concerning the biodegradation of the compounds from natural sorbents from environment. Acknowledgements This work was supported by Ministry of Education, Science and Technological Development of the Republic of Serbia, Project No: III 43004.

TU280 Applying high-resolution mass spectrometry to evaluate chemical persistence in un-spiked natural waters

Z. Li, Stockholm University / ACES; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES) Microbial degradation (biodegradation) is an important mechanism for removal of organic contaminants in natural systems. The OECD 309 guideline is a fundamental determining the environmental fate of the compound. The OECD 309 guideline (“Aerobic Mineralization in Surface Water”) is one of the most important tests for providing kinetic biodegradation data in surface waters for use in persistence assessment and risk assessment. The OECD 309 simulation test measures biodegradation in aerobic natural waters that have been spiked with test chemicals and incubated in laboratory systems. The biodegradation conditions do not accurately simulate natural aquatic environments, where a variety of microbial organisms are exposed to chemicals with much lower concentrations. As a result, legitimate questions have been raised about the ability of standard biodegradability tests to predict persistence of compounds in natural systems. This study was designed to test the hypothesis that biodegradation is significantly different in a spiked system than in a natural system, OECD 309 experiments were carried out with and without spiking. Water from Lake Norra Bergudansjön in southern Sweden was used, a recipient for wastewater treatment plant effluent with a freshwater dilution factor of 4. A mixture of 16 test compounds comprising a range of biodegradability was used for the spiked systems. Four sets of experimental conditions were used (all in duplicate), i.e., spiked lake water, un-spiked lake water, spiked artificial lake water (inflowing lake water mixed with the effluent (80:20, v/v) from the wastewater treatment plant which discharges into the lake), and un-spiked artificial lake water. Incubation conditions followed the standard OECD 309 protocol, lasting for a period of 60 days at 20 °C in the dark. Triplicated water samples were collected at 11 time points. After addition of different standard, the samples aliquots were filtered and analyzed with UHPLC-Orbitrap-MS/MS using direct injection. Data was processed using both the target approach and the non-target approach, where the implementation of liquid chromatography coupled to high-resolution mass spectrometry allows for screening of organic contaminants in aquatic systems. The biodegradation kinetics (half-lives) of the detected compounds in the spiked and un-spiked waters will be compared and contrasted to evaluate the hypothesis.

TU281 A Ultimately Transformed Organic Carbon (UTOC) approach to assess biodegradability of complex chemicals

M. Cregut, F. Brillet, University of Nantes / GEPEA CNRS UMR CBAC Laboratory; C. Sweetlove, IOREAL SA / Research and Innovation; J. Chenébl, IOREal Research / Research and Innovation; J. Lhiardon, IOREal Research & Innovation / Life Sciences Direction; T. Gerald, University of Nantes / Microbiology According to the United Nations (UN), a substance is the “chemical elements and their compounds in the natural state or obtained by any production process”. This definition has evolved according to different acts of regulation. Another category of substances is UVCB: Unknown or Variable composition, Complex reaction products or Biological materials” such as crude oils or vegetal extracts. In addition, there are “mixtures or solutions composed of two or more substances in which they do not react”. The assessment of complex mixture biodegradability can be limited by technical issues and/or difficulties in the inherent biodegradability. This work is composed of three different studies to introduce and improve the biodegradation. The UTOC includes the inorganic carbon resulting from respiration and the carbon assimilated by microorganisms. This measurement strategy was initially compared to a DOC DIE-AWAY test (i.e. OECD 301 A) and then successively tested and validated with non-soluble chemicals, pure and in an emulsion mixture (consisting in a virtual cosmetic formula). The UTOC approach highlighted the beneficial effects of an emulsion on the biodegradation of these substances. Prior to assess a natural complex mixture, pass levels to differentiate unequivocally ready and inherent biodegradability were determined. This latter step aims to reinforce safety for substances of unknown complex composition. Based on the principle of reducing the probability of persistent parent products or generation of toxic-by-products during biodegradation, the UTOC approach was reinforced with ecotoxicological tests using a weight of evidence approach for a moderate % of biodegradation. Finally, the methodology was assessed and validated by an investigation of the biodegradability and ecotoxicology assessment of a complex mixture of substances. This concept has been shown to provide a robust safety assessment approach, and further research should focus on more complex substances (viscous or solid, absorbable, volatile). The advantages of UTOC are clear; it appears as an appropriate method to quantify the initial raw material converted to an inert product by the action of microorganisms to determine the ready biodegradability of an unknown substance such as a vegetal extract.

TU282 Development of a multi-sensors device to assess the biodegradation of chemicals

M. Cregut, University of Nantes / GEPEA CNRS UMR CBAC Laboratory; v. le curtif, I. Catherinot, E. Calzolari, Y. Pichot, TRONICO; C. Sweetlove, IOREAL SA / Research and Innovation; E. Grangé, S. Jouanneau, University of Nantes / GEPEA CNRS UMR CBAC Laboratory; M. Durand, University of Nantes / UMR CNRS GEPEA CEBAC Laboratory; J. Chenébl, IOREal Research / Research and Innovation; A. Lahmar, University of Nantes / GEPEA CNRS UMR CBAC Laboratory / Research and Innovation; T. Gerald, University of Nantes / Microbiology Most of the methods used to evaluate biodegradation have been developed for almost 50 years. According to the fact that annually, hundreds of new chemicals require a biodegradability assessment; the development of new methodological solutions need to be investigated. Indeed, few measurement systems, enabling an automated assessment and in situ analysis, are available from those based on manometric or oxygen consumption measurements, which present certain limitations to assess complex or volatile chemicals. To increase the reliability of the assessment, notably for volatile and complex chemicals, our objective was to develop a multiparametric platform disposing of its own measuring methodology. A research project was therefore conducted to develop this methodology while integrating automation of measurements to tackle another major challenge in biodegradation assessment. To reach this technological bottleneck, a validation of different technologies of sensors has been performed to assess their reliability and accuracy in operating conditions. This first step is crucial prior to establish a carbon balance analysis, using several
modeling steps involving the use of different parameters such as $O_2$, $CO_2$, pH, T°C, Pressure and Biomass. These technological investigations will be used to create an unique automated device enabling the evaluation of biodegradation of a chemical whatever its physicochemical characteristics.

TU283 Investigations on key parameters of an innovative biodegradation test based on cell proliferation

S. Rey, Firmenich / Biotechnology; B. Özel Duygan, University of Lausanne / Fundamental microbiology; S. Leocata, L. Baroux, P. Merle, Firmenich; J. van der Meer, University of Lausanne / Department of Fundamental Microbiology; M. Seyfried, Firmenich

Still, the OECD screening tests for biodegradation are useful tools for determining the potential of chemicals to undergo decomposition and mineralization in the environment. Most of these are carried out at high test compound concentration and are based on simple readouts such as $CO_2$ formation or oxygen consumption, and usually neglect biomass formation. Our research attempts to fill a gap in the knowledge on bacterial physiology in tests conducted at more environmentally relevant concentrations of industrial chemicals compared to existing OECD 301 series tests. Recently the feasibility of performing cell counting by flow cytometry was demonstrated for mixed cultures from WWTP sludge and lake water. The present poster reports on key parameters of this new biodegradation test method, notably effects of initial cell and test compound concentration and test duration on the test outcome, as well as on yield determination and on data analysis of flow cytometry cell counting. As test compounds, selected reference chemicals were chosen from the ECETOC MCC/007 report list suggested for method development for readily and non-biodegradable compounds. Alongside cell counting, several test compounds were analyzed in parallel for $CO_2$ and disappearance of parent compound, and comparison with results from standard screening tests will be presented.

TU284 Challenges and Solutions of Ready Biodegradation Study with Difficult Substances

T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; T. Sasa, D. Tomiyas, Kao Corporation / Safety Science Research; M. Yamane, Kao Corporation / Safety Science; D. Montia, Kao Corporation / Safety Science Research

Ready biodegradation studies (OECD TG 301) are required for registrations and the development of chemicals for various applications. Current test systems work well for many substances, but some substances, called “difficult substances” sometimes fail to biodegrade in these test systems. Here challenges and solutions on ready biodegradation studies are presented with water insoluble or/and volatile substances, as examples of “difficult substances”. A hydrocarbon, 15-methylhentriacontane, is insoluble in water and tends to stay on the surface. An initial ready biodegradation study indicated that it was not readily biodegradable. It was hypothesized that this was because the microorganisms could not access the test substance well on the surface water. To overcome this challenge, the test substance was wrapped in a nylon sheet so that it could stay in the water for access by the microorganisms. With this test system, the biodegradability was remarkably improved and it was regarded as ready biodegradable. This method and result were accepted by the Japanese authority. An aromatic chemical, 3,5,5-trimethylhexanoic acid, is insoluble in water and tends to stay on the water surface and volatilize. An initial ready biodegradation study indicated that it was not readily biodegradable. It was hypothesized that this was because the test substance disappeared from the test system by volatilization. To elucidate this hypothesis, the concentration of the test substance and a possible hydrolyzed metabolite were monitored by chemical analysis in the water phase. The result indicated that the test substance volatilized within 48 hours. This result strongly suggested that the low biodegradation result was due to the rapid volatilization and disappearance of the test substance from the test system. The possible solutions to this challenge will be discussed in the presentation.

TU285 Influence of inoculum origin and adaptation on biodegradation of emerging contaminants

B.A. Poursat, University of Amsterdam/IBED Institute / Institute for biodiversity and ecosystem dynamics; J. Dalmin, University of Amsterdam / IBed; M. Braster, VU University Amsterdam; R. Helmus, University of Amsterdam / IBed; R.J. van Spanning, VU University Amsterdam; P. de Voogt, University of Amsterdam / IBed; T. Persson, University of Amsterdam / IBed

Assessment of microbial biodegradation is a key parameter for estimating the environmental risk of new organic chemicals. Commonly used tests for the assessment of ready biodegradability (RBTs) have been designed as simple and inexpensive methods to identify chemicals that are not expected to be environmentally persistent in most of the ecosystems. However, RBTs suffer from several problems that lead to a high variability of the results and, hence, to difficulties in their interpretation. These tests are low throughput, space consuming and poorly reproducible. Moreover, the origin of the inoculum is also a cause of variability in RBTs results. Pre-exposure of the inoculum to the tested chemical prior to any test has been proposed as a method to improve biodegradability testing. Pre-exposure could allow a better persistence prediction of chemicals present at low levels in wastewater or of newly produced chemicals by including the natural adaptation ability of microbial communities. Therefore, in order to assess the influence of the inoculum origin and of pre-exposure on RBTs, we compare the biodegradation capacity of activated sludge from different Dutch wastewater treatment plants before and after pre-exposure to five different chemicals. Carbamazepine, diclofenac and metformin are commonly detected pharmaceuticals in wastewater, while 4-chloroaniline and N-methylpiperazine are industrial chemicals with erratic behaviour in RBTs. In this research, an effort is made to miniaturize the standard OECD 310 procedure. As this test requires large volume vessels, it is difficult to perform large scale tests with multiple inocula and compounds using this great volume, sealed bottles. 80 well plates are used for the incubation and elimination is measured by following the $CO_2$ production (OECD 310) and the compound concentration by LC-MS/MS. The results of these experiments are expected to show differences between responses of inocula that are not pre-exposed. After pre-exposure we expect to reduce the risks of errors of test results and to enhance biodegradation. Different responses between the different inocula will give valuable information about the future environmental fate of the tested compound. Finally, this knowledge will develop more accurate ready biodegradation testing and lead to a more comprehensive environmental risk assessment of persistent chemicals.

TU286 Investigations on the role of adaptation in OECD biodegradation screening tests

F. Miffon, C. Dick, Firmenich; K. van Ginkel, Akzo Nobel; M. Seyfried, Firmenich

Until recently, adaptation was recognized by the European Chemicals Agency as one of the options in so-called enhanced ready biodegradation tests (RBTs) to provide proof of non-persistence of a test chemical. Since June 2017 (time of publication of the latest Guidance on Regulatory Safety Assessment Chapter R.7b: Endpoint specific guidance), adaptation has been explicitly excluded. This decision was presumably based on the concern of a perceived lack of capacity for adaptation in the natural environment but failed to provide scientific justification to generally put into question the environmental representativeness of lab results obtained from lower tier tests. As shown previously, positive results from enhanced RBTs are useful in persistence assessments and help avoid false negatives, usually resulting from the stringency of this type of tests. Based on previous results obtained from enhanced RBTs conducted after adaptation, we selected a structural family of compounds for which solid and reproducible effects were seen after adaptation with different inocula. One of our goals was to get in detail regarding the influence of initial ready biodegradation and adaptation. The outcome of this study will form the basis for further investigations on the environmental representativeness of positive results obtained from enhanced RBTs with adapted inocula.

TU287 Use of Chemical Analysis to Enhance Interpretation of Biodegradability Tests: A Case Study with Two Gas-to-Liquid (GtL) Products

J. Dawick, G. White, C. Hughes, Shell Health / Risk Science Team

The Oslo Paris (OSPAR) Commission, which oversees the OSPAR Convention, currently implements the harmonised mandatory control system (HMCS) for use and reduction of discharges of chemicals in the exploration and production of oil and gas offshore in the North East Atlantic. Chemical suppliers must submit a Harmonised Offshore Chemical Notification Format (HOCNF) to the implementing OSPAR member state authority to certify use of their products offshore. Marine biodegradation screening tests (BST’s) are an intrinsic part of offshore chemical control schemes and the HOCNF registration process. However, the lack of robustness of the marine biodegradation methods has been highlighted in a series of ECETOC workshops, particularly when these are used to assess complex, volatile and poorly water-soluble substances (e.g. petroleum products). We have found that the inclusion of abiotic controls and chemical analysis for total petroleum hydrocarbons (TPH) in freshwater BST’s demonstrates that disappearance of test substances from the test system is often far greater than is suggested by the biodegradation test and that abiotic losses may explain the majority of the test results. Here we present the preliminary results from two marine BST tests (OECD 306 and BODIS) conducted on two synthetic hydrocarbon Gas-to-Liquid (GtL) products. In addition to measuring ultimate biodegradation (by oxygen uptake) in these tests, additional analytical techniques have been incorporated to enhance the interpretation of results. Extraction and analysis of test samples using gas chromatography has been conducted to i) confirm substance dosing and ii) understand the extent of abiotic losses in the test system. In addition, two-dimensional gas chromatography (GCxGC) was employed to characterise hydrocarbons present in test samples, which were compared back to the composition of the original test substances. An overview of the results and our recommendations on how marine biodegradability tests can be improved and interpreted will be provided. REFERENCES ECETOC Workshop Report No.34 – Improvement of the OECD 306 Screening Test. Published September 2017. Available online via: http://www.ecetoc.org/publication/workshop-report-no-34-improvement-oecd-306-screening-test/; Hughes, C., Whale, G., Mead, C. (2015). Investigation into the
TU288
Organising an international ring test to improve the marine biodegradation screening test
A. Qureshi, A. Shama, B. Rowles, N. Baudin, C. Mckillican, G. Ben - Analytical Science; C. Mckillican, Syngenta Crop Protection LLC / Product Metabolism and Analytical Science; G. Ben

TU289
Tissue-specific accumulation of triphenyltin compounds in marine fishes in subAntarctic waters
A. Qureshi, A. Shama, B. Rowles, N. Baudin, C. Mckillican, G. Ben - Analytical Science; C. Mckillican, Syngenta Crop Protection LLC / Product Metabolism and Analytical Science; G. Ben

TU290
POPs in the terrestrial environment of Schirmacher Hills, Antarctica: A preliminary study and implications for PCB degradation kinetics
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TU291
Degradation of crop protection products in Brazilian soils
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TU292
Study of the Degradation of Bisphenol A by the basidiomycete fungus Trametes versicolor, via HPLC-DAD/MS
C.E. Gracio, V. Bianchi, P.G. Silva, A.C. Montini, E.C. Lima, C.L. da Silva, UFABC / CCNH

TU228
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Bisphenol A (BPA) is a compound widely used in the industry and is a pollutant of emerging concern. It is classified as a pollutant of emerging concern because of its persistence in the environmental systems and its uncertain damages to both human and animal health. Some studies connect the exposition to this compound with cancer and other diseases. In this work, we evaluated the ability of the fungus Trametes versicolor (Institute of Botany of São Paulo) in degrading BPA by growing the mycelium in a enriched liquid medium and adding a Sigma brand product to it. After that, 2nd, of sample were periodically purchased and analyzed in an Agilent 1200 Series HPLC with DAD detector. 87.78% of removal was the average efficiency of the degradation; slightly smaller than other species that our group has investigated in previous works, such as Trametes villosa. In this study, we evaluated the ability of the fungus Trametes versicolor (Institute of Botany of São Paulo) in degrading BPA by growing the mycelium in a enriched liquid medium and adding a Sigma brand product to it. After that, 2nd, of sample were periodically purchased and analyzed in an Agilent 1200 Series HPLC with DAD detector. 87.78% of removal was the average efficiency of the degradation; slightly smaller than other species that our group has investigated in previous works, such as Trametes villosa. In
future works, the activity of the enzymes like Laccases and Manganese-Dependent Peroxidase should be taken into consideration and evaluated, as well as to compare the degradation with an abiotic system containing the BPA pattern – in order to evaluate its persistence in the culture medium.

TU2/93 Soil dissolution of paraffin oils: Improvement of the microbial degradation and impact on soil dissolution.

P. Adrián, A. Barret, CEHTRA SAS; G. Destrycker, CEHTRA, P. Lemaire, TOTAL Fluids

The study was conducted according to OECD 307 and the active substance applied onto soils according to Good Agricultural Practices in EU. Four soils were freshly collected from sites in Germany and handled per the International Standards – Organisation Standard ISO/DISS 10381-6 Part 6 and Good Laboratory Practices. Following incubation the soil samples are extracted and further analysed by GC/MS i.e. monitoring of one ion (m/z) for the internal standard (66 m/z) and one ion for the test substance (57 m/z). Satisfactory method performance was achieved at each degradation interval, as verified by recovery efficiency testing. The test substance, Paraffin Oil CAS (72623-86-0) as produced by TOTAL Fluids, dissipated to below 50% of the original concentration over a 17-day period after the initial treatment (DAT) in all four soils evaluated in the study. From 17 DAT through 122 DAT the concentration of Paraffin Oil CAS (72623-86-0) as produced by TOTAL Fluids, dissipated to below 80-90% dissipated in all four soils evaluated. From 122 DAT through 300 DAT there was no substantial dissolution of Paraffin Oil CAS (72623-86-0) as produced by TOTAL Fluids occurring. Two treated soil samples were then treated with dextrose, ammonium nitrate and monopotassium phosphate in order to improve the remaining bioactivity. The remaining residues of the applied substance was then followed for two weeks. The results showed that for one soil a complete dissipation of the remaining residues occurred although in these time of incubation a plateau was observed. The results of the study and methodology is therefore proposed to demonstrate for certain chemicals that the degradation is of biological origin and to integrate these results in the proposed end points.

TU2/99 Leaching of PAHs from Coal Mining Heap Samples from the Saarland

T. Schiedek, Applied Geosciences / Applied Geoscience

After 250 years coal mining stopped 2012 in the Saarland, Germany. Ca. 80 mining heaps remained (up to 100 m tall). Heaps contain a significant amount of natural coal, well known as a source of polycyclic aromatic hydrocarbons (PAHs). PAHs are pollutants with high persistence, toxic impact on organisms. This study aims at quantifying the leaching of PAHs which could potentially occur under almost real conditions leached from heap sediments. Samples (top 10 cm) from heaps of Duhelam, Göttelborn, Lydia, Reden, Viktoria and 2 coal samples, were extracted and used in batch experiments. Leaching experiments with an automatic extraction unit (Dionex300) were executed, using acetone (potential leaching) and water at different temperatures (40°C and 80°C, “real” leaching). Additionally, batch experiments (static) were performed on TOP EXTRACT. Existing in any real conditions occurring. Two treated soil samples were then treated with dextrose, ammonium nitrate and monopotassium phosphate in order to improve the remaining bioactivity. The remaining residues of the applied substance was then followed for two weeks. The results showed that for one soil a complete dissipation of the remaining residues occurred although in these time of incubation a plateau was observed. The results of the study and methodology is therefore proposed to demonstrate for certain chemicals that the degradation is of biological origin and to integrate these results in the proposed end points.

TU2/95 Bioaccumulation of toxic elements (PTE) in marine mammals and cartilaginous and bony fish to assess their quality for predators.

V. Felten, LIEC / LIEC-CNRS UMR; J. Leflaive, ECOLAB UMR CNRS; A. Bec, Université Clermont Auvergne; J. Ferriol, ECOLAB UMR CNRS

In the marine environment, food is the main route of entry for contaminants. Their transfer to marine mammals is largely regulated by their feeding habits. To refer to the American marine mammals, oil pollution and heavy metals are the main contaminants that marine organisms faced, whereas for marine mammals, metallic trace elements (MTE) are considered as additional food for predators. To date, most studies have tried to understand the impacts of stressors on marine mammal communities. Such changes could affect the ability of marine mammals to control the negative impacts of their exposure to non-essential elements. Today, anthropogenic activities induced a continuous increase of Hg concentrations in marine environments, altering the natural Hg biogeochemistry as well as the food web in marine communities. Such changes could affect the ability of marine mammals to control the negative impacts of their exposure to non-essential elements. The best known detoxification process is the demethylation of Methyl-Hg by Selenium (Se) forming granules of tiemannite (Hg:Se) in their liver. Today, anthropogenic activities induced a continuous increase of Hg concentrations in marine environments, altering the natural Hg biogeochemistry as well as the food web in marine communities. Such changes could affect the ability of marine mammals to control the negative impacts of their exposure to non-essential elements. Here, we investigated the temporal trends of Hg and Cd in liver and kidneys (main storage tissues) of 183 individuals of the smallest cetacean species in the North Atlantic: the harbour porpoise (Phocoena phoena). Both elements showed a significant increase (p < 0.05) of concentrations between 1999 and 2013. Notably, we highlighted a strong increase of the number of individuals exhibiting extreme values among the range of measured concentrations. In parallel, we analysed essential trace elements in 78 forage species (i.e. jellyfish, crustaceans, cephalopods and cartilaginous and bony fish) to assess their quality for predators. Results showed broad differences of their essential element composition. In particular, selenium concentration can be considered because of its long-range transport over the atmosphere and its various toxic properties. As such, biofilm can play a central role in the transfer of Hg to higher trophic levels in freshwater ecosystems. By taking this into account, we can better predict effects of Hg in these ecosystems. Therefore, we conducted an experiment where single Daphnia magna clones were exposed at 20 µg/L and 2 µg/L Hg (HgCl2) in the presence and absence of biofilm. Our objective was to test for a significant effect of Hg accumulation in biofilm on Hg accumulation in daphnids. Results showed no significant effect of biofilm on Hg uptake in Daphnia. However, biofilm served as an additional source of selenium (Se) to daphnids, thereby increasing Se/Hg molar ratios in the animals. Thus, biofilm played a central role in the transfer of Se through the freshwater food web and in decreasing the risk from Hg toxicity in Daphnia.

TU2/98 Multiple stressor effects on resource quality for consumers: a case study with phototrophic biofilm exposed to phosphorus and ionic silver

M. Danesc, K. Sanchez-Thrioran, LIEC; C. Crenier, LIEC Université de Lorraine CNRS; C. Calvez, Université de Lorraine CNRS; L. Tardieu, ECO2BR ENSC; L. Thirion, LIEC; C. Crenier, LIEC

Contaminants in aquatic ecosystems, representing an essential resource for many invertebrate consumers. To date, most studies have tried to understand the impacts of stressors on microbial communities or on functional processes taking place into the biofilm mat. Far less studies investigated the indirect effects of stressors on upper trophic levels through alterations of the quality of biofilms. We investigated, through a laboratory study, the single and combined effects of phosphorus (P) availability and silver contamination on the elemental (Ca/P ratios) and biochemical (fatty acid profiles) compositions of a diatom-dominated biofilm. We hypothesized that 1) P would enhance the elemental quality while 2) P and silver, through the replacement of diatoms by more tolerant producer species, would reduce the
biochemical quality of biofilms for their consumers. The quality of biofilms for consumers was assessed for a common crustacean species, *Gammarus fossarum*, by measuring organisms survival and growth rates. Results mainly showed that species replacement induced by both stressors affected biofilm fatty acid compositions, and that P immobilization permitted to achieve low C/P biofilms, whatever the level of silver contamination. Gammarids growth and survival were not significantly impacted by the ingestion of silver-contaminated resource. On the contrary, we found a significant positive relationship between the biofilm P-content and gammarids growth, while biofilm fatty acid contents were unrelated to this parameter. This study underlines the large indirect consequences stressors could play on basal resources quality for consumers, and, in turn, on the whole food web.

**TU299**

Soil pollution induced changes in leaf litter chemical composition and in detritivore physiology and activity.

A. Le Navenant, LIEC - Université de Lorraine CNRS; E. Bililo, Université de Lorraine, CNRS UMR 7380; A. Cébron, LIEC CNRS UMR Université de Lorraine; S. Cox, CEFE, CNRS, Montpellier; V. Felten, LIEC / LIEC UMR Université de Lorraine; J. Nahmani, LIEC-CNRM, Montpellier; F. Maumoury-Danger, LIEC - Université de Lorraine - CNRS

In terrestrial ecosystems contaminated with high metal contents (brownfield), recent studies showed that, surprisingly, leaf litter decomposition process could be maintained despite deep changes in bacteria to fungal abundance ratio and invertebrate detritivore community structures. To disentangle the potential mechanisms leading to this pattern, we e\-valuated chemical characteristics of birch litter (*Betula pendula*) produced on 10 sites along a metallic contamination gradient to assess the effects of the contrasted litter characteristics on microbial colonization and litter consumption by the, the diploposed *Glomeris marginata*, used as a model detritivore. Our results reported an impact of soil contamination on leaf litter chemical composition, leading in turn to significant impacts on diploposed physiology (in particular increasing phosphorus losses when diploposed were exposed to contaminated litters). However, pollution mediated changes in leaf litter chemistry had no significant impacts on microbial litter colonization (bacteria/fungi ratio) and litter consumption by detritivore, confirming the high resistance of litter decomposition process to soil metallic contamination.

**TU300**

Decomposition rates and feeding activity of soil fauna in relation with stages of plant colonization in mine soils of a Mediterranean area

A. Pehalver- Alcalá, J. Álvarez-Rogel, M. Tercero Gómez, Escuela Técnica Superior de Ingeniería Agronómica. Universidad Politécnica de Cartagena / CITIC; J. Tetzner, M. Gonzalez-Alcaraz, Department of Biology & CESAM - University of Aveiro / Biology & CESAM

Organic matter decomposition (tea bag index) and feeding activity of mesofauna (Bait Lamina) were studied in an abandoned mine tailings area. Six environments were studied: A) Within the mine tailings: 1. Bare soils (S); 2. Small groups of *Pinus halepensis* trees (2-5) ≤2.5 m high, growing scattered (P); 3. Isolated *Pinus halepensis* trees >≈4 m high and shrubs and herbs under the canopy (DP+MS); 4. Dense patches with several *P. halepensis* trees (>≈4 m high and shrubs and herbs under the canopy (DP+MS)). B) Outside the mine tailings: 5. Polluted forest with *P. halepensis* trees >5 m high and shrubs and herbs under the canopy (PF); 6. Control forest not contaminated with *P. halepensis* trees >5 m high and shrubs and herbs under the canopy (CF). Roobois and green tea bags were buried in each environment for 60 days. Tea bags were regularly collected from each environment, to calculate mass remaining, decomposition index and organic carbon and nitrogen of the remaining material. In each plot, two groups of 5 baited sticks were vertically inserted. The number of holes partially and fully empty after 20 days was recorded to calculate the % of holes fed upon. After ≅50 days, the percentages of mass remaining in the tea bags were: - DP+MS, P+MS and S: green tea ≈50-55%, roobois tea ≈90% - PF, CF and P: green tea ≈80-85%, roobois tea ≈90%. These percentages were maintained until the day 110. The lower decomposition in CF and PF can be related with more abundance of resources in forest soils outside of the tailings which could induce to microorganisms to use other sources of nutrients different from tea material. However, in more stressed environments, such as soils with a phytotoxic source of contaminants easily decomposable, mainly the green tea, could stimulate microbial activity by a priming effect. Besides, within the tailings, the decomposition in S (the most unfavorable environment "a priori") could be favored by the high soil temperature (average ≈28°C), as a consequence of the lack of vegetation, while in other environments the shading by plants maintained the temperature between ≈23 and ≈25°C. Feeding activity was (4% of holes fed upon) ≈22% in P+MS, ≈31% in S, ≈25% in CF, ≈36% in PF and ≈46% in P. AF = 8%, DP+MS = 7%. The high % of holes fed in bare soils (S) could be related to the scarcity of resources in this environment which stimulated the consumption of the bait.

**TU301**

Effects of mineral supplements on lead exposure in free-ranging herbivores

J. Pareja Carrera, IREC-UCLM / IREC-UCLM; M. Martinez-Haro, IREC-Instituto de Investigación en Recursos Cinegéticos / Department of Life Sciences; J. Rodríguez-Estival, University of Castilla-La Mancha / IREC-UCLM; J.E. Smits, University of Calgary / Ecosystem and Public Health; M. Durkalec, National Veterinary Research Institute / Department of pharmacology and toxicology; R. Mateu, IREC-CSIIC- UCLM / Grupo de Toxicología de Fauna Silvestre Lead (Pb) mining has contributed to the extensive release of Pb into natural environments for centuries. In former mining districts, now on the Iberian Peninsula mainly livestock and hunting estates, Pb persisting in the soils and vegetation of affected areas may play an environmental and health risk. Since Pb is an important toxic metal for both animals and people, the methodology to explore how to prevent or reduce exposure. Therefore, we studied the effect of commercial mineral supplements on Pb bioaccessibility through laboratory and field approaches. One aim was to prevent or reduce absorption in herbivore inhabiting mining areas and thus reduce the possible exposure route to people. In our previous work, we identified one mineral supplement rich in calcium (Ca) and phosphorus (P) that specifically altered Pb solubility and absorption in a digestive tract simulation model. Here, we go one step further to evaluate the effects of that commercial mineral supplement on Pb absorption and on immune status in goats from an old mining area. Two groups of goats from two plots with similar soil Pb concentrations were selected. One group was supplemented with the commercial mineral salt for 20 days, whereas the other one served as control. Then, the Pb exposure was evaluated in blood, milk and feces, and the phytohaemagglutinin (PHA)-skin test was used to evaluate T-cell-mediated immunocompetence. Results showed that all goats responded to the PHA, but no significant difference was detected between groups. Blood and milk samples were collected the same days that the PHA-skin test was conducted. Blood Pb levels in supplemented goats were significantly lower than in control goats. The two complementary methods used a cost-effective measure to reduce Pb exposure of livestock and wildlife in areas contaminated with Pb. An assumed additional advantage is reduced the risk of Pb exposure through milk consumption by the local human population.

**TU302**

Analysis of anticoagulant rodenticides, neonicotinoids and fipronil in liver of predatory birds


Pesticides in predatory birds have been drawing much attention worldwide in regard to species declining and protection. Pesticides are used for pest management of animal species such as commensal rodents and sap-sucking insects. However, pesticides can lead to secondary poisoning, when predators take up pesticides residues from primarily exposed target or non-target species. The analysis focused on anticoagulant rodenticides, neonicotinoids and fipronil which were regularly applied in the years 2011 to 2013. We obtained liver samples of 89 avian predators from this period, which were collected from veterinary institutions or private persons from 26 administrative districts in Germany. Avians were found dead or were euthanized shortly after admission to the veterinarian. Defrosted liver samples were spiked with surrogates and homogenized in a mixture of methanol and water (2:1 v/v) and cleaned up by solid supported liquid extraction with a diatomaceous earth cleaned cartridges. One to four substances of the rodenticides (Brodifacoum, Fenticarb and Fipronil) were found in 30% of the liver samples, originated from primarily exposed target or non-target species. In general, the maximum levels of total content and content which was to be measured were found in liver, blood and muscle samples of common buzzards (*Buteo buteo*) contained residues. The portion was with 80% even higher for red kite (*Milvus milvus*) but only 5 samples of this species were examined. A residues distribution pattern will be presented but more samples are necessary for final statements.

**TU303**

Trophic Magnification of POPs including PFCs Within A Terrestrial Food-Web Of An Avian Top Predator, the Cooper’s Hawk (Accipiter Cooperii)

303

SETAC Europe 28th Annual Meeting Abstract Book
Spatial comparison of contamination and biomagnification profiles of biota, highlighting the importance of riverine than zooplankton from the outer fjord. We also found higher Hg forces for the zooplankton community, and zooplankton from the more freshwater clear seasonal patterns. Nutrients reflected both physical mixing patterns as well as stable isotope measurement (analysed and trophic position and food origin was established with the help of and zooplankton composition. Metabolic enhancers, nutrient load - all factors that may affect food webs in different manners, Terrestrial inputs can also directly and indirectly influence inputs, bioavailability and food web uptake of contaminants such as mercury (Hg). While several studies exist on effects of bioaccumulation of contaminants, there is considerably less known about OC legacy POPs. The targeted POPs were characterised as a function of their lipophilicity and octanol-water partition coefficient (log Kow). Due to their higher log Kow, POPs are expected to show an increased biomagnification potential at higher food chain positions. In the present study, we investigated the biomagnification potential of TPT in the food web including terrestrial materials. Preliminary results showed that seawater samples from WO harboured higher concentrations of TPT than biota samples indicated a concentration gradient from the western to southern waters (W1 > W0 > SL > SE). The above findings were consistent with our hypothesis that the western waters are more polluted than the southern waters due to the influx and polluted freshwater from the Pearl River. Our forthcoming results on whether TPT can be biomagnified in the higher trophic organisms will further shed light on its biomagnification potential at the higher food chain with consideration of its lipophilicity and octanol-water partition coefficient (log Kow).

**TU306 Comparative trophodynamics of polychlorinated biphenyls and chlorinated paraffins in an urban river system**

P. Labadie, UMR CNRS EPOC Universite Bordeaux / UMR 5805 EPOC; A. Gouffe, EPHE / UMR METIS; K. Maciejewski, UMR EPOC; C. Simonnet-Laprade, UMR5805 EPOC; K. Le Menach, UMR CNRS EPOC Universite Bordeaux / EPOC UMR 5805; F. Alliot, EPHE / UMR Metis; R. Santos, Hepia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; H. Buziñski, University of Bordeaux

Trophic magnification factors (TMFs) have been extensively used to assess the biomagnification potential of organohalogen in numerous aquatic and terrestrial ecosystems. While the trophodynamics of legacy persistent organic pollutants is relatively well known, that of emerging halogenated contaminants remain scarcer documented. This is partly due to the low concentrations of POPs relative to their higher log Kow, POPs are expected to show an increased biomagnification potential at higher food chain positions. In the present study, we investigated the biomagnification potential of TPT in the food web including terrestrial materials. Preliminary results showed that seawater samples from WO harboured higher concentrations of TPT than biota samples indicated a concentration gradient from the western to southern waters (W1 > W0 > SL > SE). The above findings were consistent with our hypothesis that the western waters are more polluted than the southern waters due to the influx and polluted freshwater from the Pearl River. Our forthcoming results on whether TPT can be biomagnified in the higher trophic organisms will further shed light on its biomagnification potential at the higher food chain with consideration of its lipophilicity and octanol-water partition coefficient (log Kow).

**TU307 Copper and mercury effective body residues in freshwater macroinvertebrates as related to benthic community metrics from a mining river basin**

I. Monaco, L. Méndez-Fernández, University of the Basque country UPV/EHU / Zoology and Animal Cellular Biology; M. Martínez-Madrid, University of the Basque Country UPV EHU / Genetics, Physical Anthropology and Animal Physiology; N. Costas, I. Pardo, University of Vigo / Ecology and Animal Biology; P. Rodriguez, University of Basque Country / Zoology and Animal Cell Biology Copper and mercury body residues in 10 macroinvertebrate taxa were used to model the alterations in benthic community metrics due to metal bioaccumulation in mining areas of the Nalón River basin (Spain). The studied taxa are potentially useful as water quality biomarkers and cover different functional feeding styles. This is part of a larger study in North Spain that aims to develop biota quality indicators.
standards of several heavy metals, to contribute to water quality management to take forward the conservation of macroinvertebrate communities. The specific objectives of the study were: first, to model the relationships between 4 macroinvertebrate community metrics (number of families and abundances of EPT and PT), one multivariate (METI) and a predictive model (NORTI), using the Cu and Hg body residues as predictor variables; second, to assess Cu and Hg toxicity to benthic communities through the estimation of effective body residues (ER); and third, to investigate the taxon-specific differences in metal ERs in relation to their feeding styles. The ERs were estimated for each taxon and metal from the best non-linear models, selected using Akaike's Information Criteria, and compared with the 90th percentiles (P90) of the data distribution in the reference sites of the study area, considered an approach to threshold (=no-effect) concentrations. All these models were fitted for Hg only in few instances for Hg. Results showed that Cu-ER$_{10}$ and Cu-ER$_{50}$ in 4 taxa (Baeidae, Hydropodidae, Ephermerellidae and Microdriil oligochaetae) were usually less than 2 times above the P90, calculated for the same taxa. These ERs in other 3 taxa (Heptageniidae, Ephermeridae, Rhyacophilidae) were mostly within the range of 2.1 to 5.0 times the P90. The largest ratios were found in ER$_{50}$ for Lumbricidae and Peridiae, which reached 12 times the P90 values. In the case of Hg, the predator taxa (Rhyacophilidae and Peridiae) and some of their potential prey, e.g. mayflies and simulids, showed ERs that were typically within the range of 1 to 3 times their respective P90s.

TU308
Trophic transfer of Cadmium nitrate in a simplified marine food chain: experimental feeding rate of gelatinous zooplankton Aurelia sp. and Sanderia malayensis on crustacean Artemia sp.

E. Costa, C. Gambardella, V. Piazza, CRN ISMAR; S. Lavorano, Costa Eduttin paint Aquario di Genova; M. Faimall, F. Garaventa, CRN ISMAR Tugriko interactions are a crucial vector of contaminant transfer in both aquatic and terrestrial ecosystems. In the marine environment, Cnidarian jellyfish are known to play an important role in food webs as major predators of zooplankton and as prey of apex predators, influencing the microbial loop, through direct and indirect effects, besides regulating the marine biogeochemical fluxes. In this study, the potential contaminant transfer was investigated in simplified marine food chains. The nauplii of the brine shrimp Artemia sp. and the ephyrae of Aurelia sp. and S. malayensis were selected as primary and secondary consumers, respectively. Cadmium nitrate was selected as toxicant. Performed experiments consisted in feeding ephyrae, every 24 hours for 5 days, with nauplii of Artemia sp. previously exposed, for 6 hours, to different concentrations (0.1-0.5-1-2.4 mg/L) of Cadmium nitrate; this range was selected through preliminary trials aimed to define the cadmium LC$_{50}$ value for crustacean larvae. At the end of feeding experiment (5 days), the effect of Cadmium nitrate treated crustaceans on ephyrae jellyfish was investigated by the “ingestion rate method”, the “predatory performance” and biometrics and bioenergetics parameters (Disch diameter, ash-free dry weight_AFDW and gross growth efficiency_GGE). In addition, 24 hours after each feeding treatment, two ecotoxicological end-points were evaluated on jellyfish ephyrae: immobilization and frequency of pulsation (number of pulsations/min). Results showed a 100% of feeding rate and predatory performance in both control and treated jellyfish (A. aurita and S. malayensis). Cadmium nitrate treated Artemia nauplii, once ingested, caused in ephyrae a decrease of Disch diameter and AFDW and attained a steady state after 24 h of NPs exposure. We also observed that internal concentrations of Fe$_{50}$ nanoparticles (NPs) were estimated to be 67 and 1768.85 mg L$^{-1}$ in worms and bacteria, respectively. In addition, the BCF of bacteria was found to be 17.69, close to the experimental results. Moreover, the BFs of NPs were maintained to be consistently smaller than 1 during 24 h exposure. Results also indicated that internal concentrations of Fe$_{50}$ in worms were mainly influenced by biomass conversion rate for bacteria ingested by worms, whereas parameter of death of worms had the smallest effect on worm internal concentrations. CONCLUSIONS: Model application to toxicokinetic results confirms the hypothesis that the consumer-resource dynamics are effectively associated with Fe$_{50}$ accumulations in bacteria and worms that bioaccumulation kinetics and consumer-resource dynamics are likely to be dominated by the same physiological parameters.

TU310
Tissular injuries in Crassostrea virginica as evidence of the trophic transference of copper and cadmium via Chlorella sp.

F. Mares-Guzman, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiologio; G. Barrera Escorcia, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiologio; X. Guzman-Garcia, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiologio

Exposure of metals to microorganisms in small quantities carrying out their biological functions. In contrast non-essential metals do not have a known biological function. When metals are incorporated by the organisms they can cause damage and their presence indicates contamination. Several human activities contribute to the increasing load of both essential and non-essential metals in the aquatic environment. Microalgae such as Chlorella sp., are the primary link in the trophic chain and in the environment, they can incorporate contaminants by absorption or adsorption. If these algae accumulate contaminants, such as metals, the organisms that feed on them like the oyster Crassostrea virginica can in turn incorporate them through filtration, which may have negative consequences. The objective of this work was to evaluate the effects derived from the trophic transfer of copper and cadmium from Chlorella sp. to C. virginica. Microalgae were cultured for 110 h at a sublethal dose of copper and cadmium (0.1 mg/L). A concentration of 30 X 10$^{-5}$ cells was given to C. virginica for 21 days. The evolution of histopathological lesions in C. virginica was evaluated in days 0, 5, 10, 15 and 20 of the assay. The analysis performed in the digestive gland revealed diverse lesions ranging from the loss of cilia and covering membranes, to the increase in the light of the digestive gland tubules, as well as the presence of various inflammatory processes. Other organs such as the gills, presented an inflammation and injuries that compromise the body’s physiological processes such as feeding and breathing. These damages were evident after the first 96 hours of exposure to the contaminated food. However, lesions found in oysters after cadmium exposure, a non-essential metal, in more than 50% of organisms/animals were observed on day 10 and those associated with more than 50% in animals in cooper exposure were deferred to day 15. The presence of Chlorella sp. in the digestive tract made possible to associate the injuries within trophic metal poisoning, and the prevalence of lesions with metal and exposure time.
perfluoranes, PBDEs, PCBs, HAPs and pesticides. In parallel with analytical methods, YES and YAS bioassays were conducted in order to quantify estrogenic and androgenic activities in surface waters. Antagonist activities were also evaluated. Over 71 river samples (concerning 24 river sampling points from the regional monitoring network), estrogenic activity was detected and quantified in 53 samples and could reach levels up to 11.7 ng E2eq/l (mean: 2.1±1.6 ng E2eq/l). Androgenic activity was detected in the other hand, estrogenic and androgenic antagonist activities were detected in 42 % and 55 % of the samples, respectively. When the estrogenic activity is compared to the EU-Watch List Eqs for E2 (0.4 ng/l), 60 % of the samples exceed this value. The estrogenic activity was compared to the chemical results. A good correlation was found with the estrone concentration but also with other ED (e.g. bisphenol A, perfluoranes). This study is, in a way, the first attempt in Wallonia to follow the recommendations for the use of effect-based methods (EBMs) for monitoring of estrogens in surface waters emanating from the Science to Policy Interface (SPI) Estrogen monitoring project. These recommendations were presented at the last EU-WG chemicals held in October 2017 and this would possibly lead to the introduction of EBM in regulatory monitoring under the Water Framework Directive (WFD), especially for estrogens.

TU313
Ecotoxicological tools to assess the impact pollution of tributaries to the Alqueva Reservoir (Southern Portugal)

P. Palma, Instituto Politécnico de Beja / Department of Technologies and Applied Sciences; S. Fialho, A. Lima, Instituto Politécnico de Beja; A. Penha, H. Novais, Instituto de Ciências da Terra; S. Fialho, A. Lima, Instituto Politécnico de Beja; N. Guillem-Arègles, Institute of Environmental Assessment and Water Research IADAA-CSIC / Department of Environmental Chemistry; N. Guillem-Arègles, Institute of Environmental Assessment and Water Research IADAA-CSIC / Department of Environmental Chemistry; P. Alvarenga, LEAF Conservation, Instituto Superior de Agronomia, Alimentos, Ambiente e Paisagem; Instituto Superior de Agronomia, Universidade de Lisboa; M. Morais, R. Salgado, Instituto de Ciências da Terra
Decoration of surface waters and biodiversity loss at different spatial and temporal scales occurs through multiple stressors whose effects are difficult to separate and identify. Efficient management of water bodies depends on the development and selection of robust, sensitive and easily applicable tools that allow prioritizing the pressures and stressors that act in a basin, and mitigate their effects. The Alqueva reservoir constitutes the most important water supply source in southern Portugal, a semi-arid region with high levels of water scarcity and where agriculture is one of the main activities. The aim of the present study was to assess the use of an ecotoxicological tool-box in tributaries of the Alqueva reservoir for detecting chemical alterations that may influence the water quality of the reservoir. Water samples were collected along 2017 at four tributaries of Alqueva (streams of Zebro, Alamos, Amieira and Lucefécit) and analyzed for: (i) physical chemical support elements (pH, temperature, dissolved oxygen, conductivity, chloride, total phosphorus, Kjeldahl nitrogen, ammonium, nitrite, nitrate, BOD, COD), (ii) pollutants, such as pesticides and heavy metals, (iii) nutrients, using bioindicators representing different trophic levels (Vibrio fischeri, Thamnocephalus platyurus, Daphnia magna). In general, Zebro and Lucefécit presented concentrations of BOD (Zebro: 4.0-35.5 mg L⁻¹; Lucefécit: 2.3-7.5 mg L⁻¹) and total phosphorus (Zebro: 0.18-6.23 mg L⁻¹; Lucefécit: 0.02-1.92 mg L⁻¹) that compromise the support of biological life, with regard to nutrient and oxygenation conditions. The concentrations detected here, and particularly low, being bentazone the compound quantified at highest levels. Lucefécit was the tributary that presented higher concentrations of pesticides (with values of bentazone of 1.94 μg L⁻¹), probably due to the intensive agriculture crops around it. Concerning to ecotoxicological analysis, the results highlighted the toxicity in sublethal parameters (reproduction, feed inhibition or growth inhibition) induced, mainly, by samples from Zebro and Lucefécit streams. So, the results from the ecotoxicological tool-box allowed identifying the streams that promote a higher chemical impact to the reservoir, which is essential to delineate management actions to improve the water quality of the reservoir.

TU314
Effects based tools for use in conjunction with passive samplers

R.J. Brown, O.L. Tran, wca consulting; G. Whale, Shell Health / Risk Science Team; M.J. Spence, CONCAWE; D. Leverett, wca
As part of an ongoing review of the Water Framework Directive (WFD), the European Commission (EC) is considering “effects based tools” (EBTs) for use as an enhancement of the Water Framework Directive to, or in combination with, the monitoring of individual substance concentrations. There are several ways in which EBTs may be integrated into environmental monitoring but one approach, which integrates chemical exposure over time, is to conduct toxicity profiling on extracts from passive samplers deployed in surface waters. The aim of this project was to provide a critical evaluation of available EBTs that could be used in conjunction with passive samplers, and propose a list of assays for use in monitoring surface water concentrations. There are several ways in which EBTs may be integrated into environmental monitoring but one approach, which integrates chemical exposure over time, is to conduct toxicity profiling on extracts from passive samplers deployed in surface waters. The aim of this project was to provide a critical evaluation of available EBTs that could be used in conjunction with passive samplers, and propose a list of assays for use in monitoring surface water concentrations. A list of possible EBTs was compiled based on recent published reviews on this topic. These assays were then broadly screened based on commercial availability, general validation maturity, previous application to environmental samples, and suitability for use with passive sampler extracts to derive a short list of 22 assays for more detailed consideration. The short-listed assays included novel whole organism bioassays (or surrogates), and in vitro or bacterial assays for endpoints based on endocrine disruption (oestrogen, androgen and thyroid), genotoxicity, oxidative stress, and metabolism of polyaromatic hydrocarbons (PAHs). Commonly used whole-organism assays (e.g. Daphnia, Zebrafish) and (i) acute androgenic and (ii) estrogens were tested in the first screening, since they are already well proven but with no detailed evaluation. If required, however, were considered as part of the final recommendations. The shortlisted EBTs were then subject to a detailed review, based on the published scientific literature, to identify relevant information with respect to their performance, interpretation, and application. The EBTs were compared using the information identified in the literature review and an initial suite of thirteen bioassays were recommended for the monitoring of surface waters associated with refinery effluents using passive sampler extracts. This recommended suite of EBTs should be considered a starting point for use in the monitoring of waters receiving refinery effluents, to be further developed based on experience in using the assays for this purpose, and incorporating new relevant bioassays once they have achieved a sufficient level of validation maturity. This review will be published as a Concawe report in 2018.
(predicted no effect concentration). Ecotoxicological effects have been detected with the algae and could be related to the substances detected (e.g. heavy metals) or other substances released in the area (transitional waterbody). In general the results show a situation in which the quality of the sediments is not in a good status, although the level of concentrations should not cause a high risk for the aquatic ecosystems; the chemical contaminants can derive from different sources of pollution (industrial, urban, agricultural, atmospheric deposition) and multiple measurements are needed to achieve the good quality status required by the water framework directive. The presence of Uranium in the marine coastal area should be further investigated to understand the possible role of the Coal fired power station.

TU317 USE OF DIAGNOSTIC STRAINS OF THE SALMONELLA/MICROSCOPE ASSAY FOR THE IDENTIFICATION OF MUTAGENIC PROFILES IN WATER SAMPLES AND SUSPENDED PARTICULATE MATTER D.A. Morales, State University of Campinas / Faculty of Technology; J. Rossetto, Martins Zwarg, School of Technology, UNICAMP; R. Massei, Helmholtz Centre for Environmental Research UFZ; T. Schröter, M. Kraut, W. Bruck, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; G. Umbuzeiro, School of Technology, UNICAMP / LACED

The Salmonella/microsome mutagenicity assay uses the genetically modified Salmonella enterica serovar Typhimurium bacterium, and the exploration of these different genetic characteristics allows the detection of various classes of mutagenic compounds. The objective of this study was to use different strains for the identification of mutagenic profiles and hinting at the class of compounds responsible for the detected mutagenicity. The research was performed with organic extracts of surface water and suspended particulate matter (SPM) collected in 13 different sites along the Danube River during the Joint Danube Survey 3 (JDS3). The extracts were evaluated with the Salmonella/microsome microsuspension assay in combination with the comet assay and the genotoxicity assay (TA98, YG1041, TA1538 and YG5185 with specific genetic characteristics for the detection of different compounds. A total of 69% surface water and 92% SPM samples were positive for at least one strain/condition. The applied methodology compared the profiles obtained at different sites along the Danube River. In this way, it was possible to detect the presence of different types of compounds that can be used as early warning indicators that are causing mutagenicity. We conclude that aromatic amines and nitro compounds for surface water and also polycyclic aromatic hydrocarbons for suspended particulate matter appear to be responsible for mutagenicity at some of the sites, because the obtained profile were similarly representative compounds of these classes. Other sites indicate the presence of other types of compounds or matrix that has been previously assigned. The aim of this research is to contribute to the comprehension and understanding of the ecological impacts caused by BT pollution and the reproductive capacity of the gastropod populations was assessed. This preliminary attempt showed that most of the sites were in a good ecological status before the ban and have reached mostly a Moderate status at present, with very few sites in Good or High status. A comparison between the two species was also performed showing advantages coming from the combined use of both species to cope with the ecological quality assessment in a wider study area.

TU320 Lessons Learned from Sibro Dam and River Restoration in Sweden E. Hallqvist, C. Becker, P. Böndökke Adamsen, P. Gliseson, A. Sahlen, Ramboll Aquatic ecosystems in the European Union are under pressure from growing demand for insufficient quantities of good quality water for human use. The Water Framework Directive requires that it is given priority to elucidate and implement strategies to improve the ecological quality of aquatic systems. The SOLUTIONS project has received funding from the European Union's Seventh Framework Programme for Research, Technological Development and Demonstration under grant agreement no. 603347.


Organic micropollutants play an important role in the assessment of water bodies that are used for drinking water production. On one hand, micropollutants pass through the wastewater system in sewage treatment plants and subsequently in surface water. On the other hand, there are direct discharges from industry and in addition, there are diffuse sources from agriculture, or from households, buildings and settlements. As major pollution events (i.e. PPC in the river Ruhr) show, water suppliers must always expect to find new critical substances that could pose a potential health risk in drinking water, especially when using surface water. For this reason, it is necessary to initiate a proactive screening of contaminants and their potential effects. Continuous monitoring by high-resolution mass spectrometry also makes it possible to analyze pollution retrospectively, gain knowledge about temporal dynamics and discharge patterns and thus identify the source of the contamination more frequently. In this context, a fast, robust and routine method for the determination of organic micropollutants is needed. This project is an approach to analyze organic micropollutants in water samples with a combination of non-target-analysis (NTA) and effect-directed-analysis (EDA). Samples were taken regularly over a period of one year in order to obtain an annual progression of the water pollution. A LC IMS QTOF system was used to carry out the NTA. Different endpoints were analyzed for the EDA: cytotoxicity (MTT assay), endocrine activities (ER-CALUX and AR-CALUX) as well as genotoxicity (p53-CALUX, umuC assay and Ames assay). Due to the investigation of raw water samples, no significant biological effect of the individual samples was to be expected. The focus of this project was therefore to analyze seasonal trends and to measure the load of the micropollutant. The coupling of NTA with a test strategy for toxicological effects forms an innovative approach with potential for preventive product quality assurance of the water supplier.

TU319 Imposex levels in gastropods from the Northern Adriatic Sea (Italy): a proposal of classification according to the Water Framework Directive F. Cacciator, ISPRA-Institute for Environmental Protection and Research / Mitigation and Protection of Impacts; R. Boscolo Brusă, C. Antonini, M. Formellewicz, ISPRA - Institute for Environmental Protection and Research; M. Marin, University of Padua; A. Bonacorsi, M. Gabelin, ISPRA - Institute for Environmental Protection and Research Butyltins (BTs) - i.e. mono- (MBT), di- (DBT) and tributyltin (TBT) - are synthetic compounds worldwide used in industrial and agricultural applications giving rise to contamination of aquatic environments. Organotins, which include BTs, were banned on antifouling paints, the main route to aquatic pollution, by Reg. 782/2003/EC. Presently, due to their persistence, toxicity and bioaccumulative properties, TBT compounds are included among the priority hazardous substances according to the European Water Framework Directive (WFD) and its daughter Directive 2008/105/EC. Imposex, the superimposition of male sexual characteristics on females of gonochoristic gastropods, is the most studied effect of TBT pollution and it is generally recognized as a specific water quality and aquatic toxicological endpoint. For this reason, under the implementation of the WFD, imposex measurements have been indicated as a useful tool to link chemical and ecological status assessment. In this context, the aim of this study was to propose a classification of imposex according to WFD using two species of gastropods collected in the Northern Adriatic Sea and in the Venice Lagoon: Nassarius nitidus (Jeffreys, 1847) and Hydrobia ulvae (Linnaeus, 1758), two species that are very sensitive to BT pollution, can be found in the inner parts of the lagoon, whereas the latter, more sensitive, occurs only near the lagoon inlets or in the sea. To define ecological Quality Ratio (EQR) class boundaries within WFD, the relationship between the ecological impact caused by BT pollution and the reproductive capacity of the gastropod populations was assessed. This preliminary attempt showed that most of the sites were in a good ecological status before the ban and have reached mostly a Moderate status at present, with very few sites in Good or High status. A comparison between the two species was also performed showing advantages coming from the combined use of both species to cope with the ecological quality assessment in a wider study area.

TU321 Impacts of methylmercury on growth, respiration and swimming in larvae of a marine forage fish

Behavioural Ecotoxicology: Unravelling behavioural responses to chemical contaminants in the environment (P)
Marine and estuarine fish accumulate methylmercury (MeHg) to elevated concentrations, often higher than in freshwater systems. Because MeHg is a neurotoxin, it is plausible that high tissue concentrations could affect behavior in marine fish which in turn could affect their populations in contaminated waters. Here we examined sublethal effects of MeHg to a marine forage fish at the larval stage, the Sheepshead minnow (Cyprinodon variegatus). Because the bioavailability of MeHg from different food types may lead to different MeHg internal distributions and toxic effects, we compared artificial and natural diets with varying MeHg concentrations. Artificial (commercial fish flakes containing methylmercury) or natural diets (zooplankton containing MeHg, obtained from MeHg-contaminated phytoplankton) were prepared; MeHg concentrations ranged from zero (controls) to as high as 7.8 ppm. The larvae were fed control and MeHg-contaminated diets from an age of 7 days until 5 weeks when they reached juvenile stage. Growth rates, respiration rates, and swimming activity were tested. Results indicate that MeHg-rich diets—either artificial or natural foods—have no significant impact on fish growth rates under any treatment. However swimming activity, (swimming speed acceleration, active swimming distance), was impaired after 3 weeks exposure to natural diets containing 7.8 ppm but not 2.5 ppm; artificial diets containing MeHg up to 4.8 ppm had no discernible effect on swimming. In addition, MeHg as low as 4.8 ppm had a small but significant impact on the respiration rates of these fish. The data suggest that mortality and growth are unlikely to be affected by these MeHg concentrations, but swimming activity may be reduced at elevated MeHg concentrations, and this could influence the success of populations in the wild through impairment of predation or avoidance of predators.

TU324 Impacts of environmentally realistic antidepressant exposure on reproductive behaviour and sperm traits in fish
J.M. Martin, M. Saaristo, Monash University / School of Biological Sciences; M.G. Bertram, Monash University / Biological Sciences; S. Hannington, J. Tanner, Monash University / School of Biological Sciences, Monash University, Victoria, Australia; M. O’Bryan, Monash University / The Development and Stem Cells Program of Monash Biomedicine Discovery Institute and the Department of Anatomy and Developmental Biology, Monash University, Victoria, Australia; B.B. Wong, Monash University / School of Biological Sciences

Pharmaceutical contaminants are increasingly being detected in ecosystems worldwide. Indeed, more than 1 in 10 currently manufactured pharmaceuticals have been found in the environment. One pharmaceutical pollutant of environmental concern is the antidepressant fluoxetine, which has repeatedly been reported in aquatic ecosystems. Worryingly, the primary target molecule of fluoxetine is conserved across a wide range of non-target species. As a result, by directly acting on the central nervous system and neuroendocrine pathways, fluoxetine can affect a range of ecologically important behavioural and physiological processes in the environment. Despite this, the effects of environmentally relevant fluoxetine exposure on processes of sexual selection in aquatic biota remain uncertain. This is because environmentally relevant exposure concentrations are often difficult to achieve in controlled laboratory settings and are fundamental to individual fitness, as well as the viability of populations and species. To address this knowledge gap, we investigated the impact of 30-day exposure to environmentally realistic levels of fluoxetine (average measured concentrations: 30 and 380 ng/L) on a range of reproductive behaviours, as well as sperm quality, in the eastern mosquitofish (Gambusia holbrooki), a promiscuous freshwater fish with internal fertilisation. We focussed on these traits because reproductive behaviour and sperm quality are both crucial fitness determinants, and are known to be vulnerable to disruption by other chemical pollutant classes. We found that fluoxetine exposure impacts reproductive behaviour in fish at field-detected concentrations, altering both association time and copulatory behaviour. We found that fluoxetine exposure impacts reproductive behaviour in fish at field-detected concentrations, altering both association time and copulatory behaviour. We observed an increase in copulatory activity in the fluoxetine-exposed fish compared to the controls. This is consistent with previous studies showing that fluoxetine exposure can alter reproductive behaviour in fish. Additionally, we found that fluoxetine exposure impacts sperm quality measures (i.e. performance and viability). In combination, our results indicate that fluoxetine exposure can alter reproductive behaviour in fish at environmentally realistic concentrations, and are known to be vulnerable to disruption by other chemical contaminant classes. We found that fluoxetine exposure impacts reproductive behaviour in fish at field-detected concentrations, altering both association time and copulatory behaviour. In summary, our results suggest that fluoxetine exposure can alter reproductive endpoints in fish, and further, highlight the need for ecoecotoxicological testing using sub-lethal exposure concentrations and ecologically important reproductive endpoints.

TU325 Determining the effects of antidepressants on multiple behaviours in a marine and freshwater amphipod
S.A. Kohler, University of Portsmouth / Animal Physiological Ecology; A. Ford, University of Portsmouth / Biological Sciences; M.O. Parker, University of Portsmouth / Biological Sciences

Behavioural assays have been gaining recognition as a viable endpoint in ecotoxicology as they provide a link between biochemical and ecological effects of environmental contaminants. Psychotropic drugs are designed to modulate behaviours in humans, and preclinical studies have demonstrated that these compounds can also alter behaviours in aquatic vertebrates. The effects of behavioural modulating drugs have been tested from a pharmacological discipline using anxiety-like behaviours including thiogammatosis (wall hugging) and scototaxis (light avoidance) on mice and zebrafish, using well-defined behavioural assays. These pharmacological methods have been translated to ecotoxicological studies on vertebrates but comparatively few have been done on invertebrate species. This ongoing study aims to translate these techniques to model crustaceans for the purpose of assessment of environmental risk using the antidepressant fluoxetine as a model compound. Specimens of the marine amphipod, Echinogammarus marinus and the freshwater amphipod Gammarus pulex were exposed to environmentally relevant concentrations of fluoxetine from 0.001–1 μg/L during 1 day, 1 week, and 2 week exposures. Activity was measured as swimming velocity and choice experiments were used to determine phototactic and thigmotactic response. Both E. marinus and G. pulex showed alterations in activity at concentrations as low as 1ng/L and as soon as 1 day compared to controls (P<0.05). Significant differences were observed in thigmotactic and phototactic behaviours both between treatments and with length of exposure. Results indicate that fluoxetine can have an effect on some amphipod behaviours at environmentally relevant concentrations. These results may have implications for future study design of these types of experiments and aid the development of high-throughput analysis on common laboratory invertebrate species.
Inter-species variability in the behaviour of a marine and freshwater amphipod

S.A. Kohler, University of Portsmouth / Animal Physiological Ecology; A. Ford, University of Portsmouth / Biological Sciences; M.O. Parker, University of Portsmouth

Individual species are used in standard ecotoxicology testing to assess environmental effects of contaminants. However, standardised invertebrate models are limited to relatively few species. Behavioural ecotoxicology is expanding with techniques and endpoints used in pharmacology being translated to other vertebrate and invertebrate species for use in ecotoxicology. Despite this, data on the control behaviours of model organisms such as crustaceans, and the inter-species variability in behaviours are currently under-studied. The aims of this study were to provide control data on a range of behaviours for use in ecotoxicological testing, using amphipods as model organisms. Behaviours commonly associated with anxiety in pharmacological studies including activity, phototaxis (light/dark preference) and thigmotaxis (wall hugging) were assessed in the marine amphipod Echinogammarus marinus and the freshwater amphipod Gammarus pulex using choice assays. Both organisms exhibited negative phototactic and positive thigmotactic behaviours (P<0.001 respectively) however, differences in sensitivity to these assays were observed between species. E. marinus showed a significantly greater sensitivity to the phototaxis assay than G. pulex (P=0.001), while the reverse was found for the thigmotaxis assay (P=0.001). Swimming velocity was used as a measure of activity. Significant differences were observed in swimming behaviour between species when exposed to a light stimulus (P<0.001) which may be attributed to differences in life histories between the two species. The results of this study provide evidence of phototactic and thigmotactic behaviours in two model crustacean species and describes two behavioural assays with potential for use in behavioural ecotoxicology. In this study we demonstrate that closely related species are capable of very different behavioural responses. The inter-species variability in sensitivity to behavioural assays found between the two amphipods in this study highlights the importance of control data on your model species for behavioural studies.

Pharmacological basis of individual tolerance to the benzodiazepine oxazepam in zebrafish (Danio rerio)

L. Vossen, Uppsala University / Department of Neuroscience; J. Fick, Umeå University / Department of Chemistry; T. Brodin, Umeå University / Department of Ecology and Environmental Science; S. Winberg, Uppsala University / Department of Neuroscience

Pharmaceuticals are common contaminants in aquatic ecosystems. Among the most prescribed pharmaceuticals globally are the benzodiazepines (e.g. Valium), a class of psychoactive drugs used to treat anxiety and induce sedation. Benzodiazepines are persistent in the environment, and their target, the GABA-A receptor, is evolutionarily conserved throughout the vertebrates. Behavioural changes have been described for juvenile Eurasian perch (Perca fluviatilis) and Fathead minnows (Pimephales promelas) at concentrations as low as 10 µg/L. Although wild-caught zebrafish (Danio rerio) show reduced fear responses after 7 days of exposure to the benzodiazepine oxazepam (1, 10 or 100 microgram per Liter), exposure is followed by an increased activity in the aquarium. This study assesses the physiological and genetic basis of this tolerance to oxazepam, focusing on development, behaviour and individual health. Both, eggs of the fish in the eyed ova stage and 8 months old juveniles were chronically exposed to four concentrations of CIT (1, 10, 100 and 1000 µg/L) in a in a semi-static three-block design accompanied by a control exposure. The larvae were exposed for 5 months at 7°C and 11°C. The experiments with juvenile fish were conducted for 4 weeks at 7°C. To investigate the effects of CIT on the embryonic development, mortality, hatching rate, and heartbeat rate were recorded. During the exposure, also behavioural endpoints were observed. Besides, several biomarkers indicative for fish health were investigated, such as cortisol-level, acetylcholinesterase activity, hsp/70-level and the histological condition of the liver. After exposure to 1000 µg/L CIT, length and weight of both larvae and juveniles were significantly reduced. Furthermore both stages showed an increased swimming activity and an increased swim up in the aquaria. An artificial swimming measurement device (small aquaria with a diameter of 17 cm), videos were recorded for 20 minutes with the aim to quantify changes in the swimming behaviour. Due to the settings of the cameras, the aquaria were strongly illuminated and the water was not ventilated during the recording. The stress situation resulted in a high activity of fish exposed for the exposure to 1000 µg/L CIT. These moved significantly less with a lower velocity than the control fish. The results of both experiments make evident that 1000 µg/L CIT affects both larvae and juvenile brown trout, on one hand by making them more agile in the aquaria, but also by depressing stress-induced floury swimming. The study is embedded in the Effect-Net (effect network in water research) Project which is funded by the Wassernetzwerk Baden-Württemberg.

TU330 Assessing the direct and indirect effects of chemical contaminants on the behaviour, ecology and evolution of wildlife: A conceptual framework

K. Arnold, University of York / Environment; M. Saaristo, Monash University / School of Biological Sciences; J. Fick, Umeå University / Department of Ecology and Environmental Science

Chemical contaminants, e.g. metals, pharmaceuticals, pesticides, are changing ecosystems via effects on wildlife. Most studies examine a limited range of endpoints, species and/or contaminants under laboratory conditions. Recent work explicitly based in ecological realism, however, reveals that chemical contaminants have direct and indirect effects on both the physiology and behaviour of animals. Given that behaviour reflects multiple physiological changes at low contaminant concentrations, and links individual- to population-level processes, it provides a sensitive tool for holistically assessing contaminant impacts. Here, we develop a conceptual framework that integrates direct and indirect effects of chemical contaminants on behaviour, under environmentally relevant concentrations and natural contexts. Within our framework, we show how the consequences of contaminants can extend beyond individuals. We use altered predator-prey interactions to demonstrate cascading contaminant effects through communities, exerting both positive and negative effects on distinct populations. Moreover, contaminants can be potent evolutionary forces selecting directly for compensatory behaviours or indirectly on downstream behaviours, via selection on resistance genes. To help implement our framework, we supply tools to design ecologically realistic experiments and risk-assessments. Although predicting effects of contaminants is complex, existing knowledge in ecology and evolution needs to be applied to this global environmental challenge.

TU331 Scent and sensibility: EE2 disrupts mate choice in fish

M. Saaristo, C.P. Johnstone, Monash University / School of Biological Sciences; K. Xu, University of Alberta / Department of Renewable Resources; M. Allison, The University of Melbourne / School of Chemistry; B.B. Wong, Monash University / School of Biological Sciences

Among the handful of studies that have studied the behavioural effects of endocrine disrupting chemicals (EDCs), only a few have attempted to disentangle the mechanisms underlying behavioural changes, such as mate choice. In fish, for example, ecological studies have shown that males base their mate choice on...
multiple cues and both visual and chemical cues play an important role in choosing the most suitable mate. Therefore, it is crucial to understand if and how EDCs affect mate choice cues (e.g., visual and chemical cues), and further, if one cue is affected disproportionately. Accordingly, the aim of this study was to investigate the impacts of a 28-days exposure to 17α-ethinyl estradiol EE2 (measured concentration 12ng/L) - a synthetic estrogen used in the contraceptive pill and a widespread contaminant of aquatic systems - on visual and chemical communication in the gym. To examine the impact of EE2 on male mate choice, we ran a standard choice assay, which was conducted in two parts to disentangle visual cues from chemical cues. First, we allowed a single male (either control or EE2) to court two size-matched females (one control and one EE2-female). In this visual cue experiment, the male was only able to see the females, but not to smell them. Second, we introduced chemical cues (control and EE2-female) to the trial tank and paired them randomly with the females. We found that there was no significant effect of EE2-treatment on total time males spent associating with the females, when given only visual cues. There was, however, a significant effect on courtship ‘sight’ display with both control and EE2-exposed males spending more time performing sight display for control females compared to EE2-exposed females. When males were presented with the two size-matched female cues, males of both visual and chemical cues, paired with control (control) and EE2 (EE2) entered the association zone more frequently, if EE2-exposed females was paired with an EE2-chemical cue. In contrast, sight display showed a reverse pattern, with males preferring EE2-exposed females that were paired with control chemical cues. Not only does our study uncover a previously unknown behavioural impact of EE2-exposure on chemical cues, but also raises the possibility that EE2-exposed males, and the role of the eyes in these effects. An Macroscopic analysis of the retinal pigment epithelium (RPE) indicated a darkening of the iris region after exposure to 4.5; 7 and 9 µg TBT L-1 weight and length, and histology of the eyes and retina. Macroscopic analysis of the retinal pigment epithelium (RPE) indicated a darkening of the iris region after exposure to 4.5; 7 and 9 µg TBT L-1 weight and length, and histology of the eyes and retina. Although the use of the antifouling contaminant tributyltin (TBT) has been banned since 2008 by the International Maritime Organization, it still persists in coastal environments due to its remobilization from contaminated sediments and also as a result of illegal use, including tropical regions along the Brazilian Atlantic Coast. *Poecilia vivipara* is a promising model for tropical estuarine fish ecotoxicological studies and we focused here on its feasibility to address fish early life stage toxicity induced anti-predator responses. We tried to escape the dish. Attractive and aversive responses have been reported to be attributed to differential activity levels in the Habenula with according activation or inhibition of the reward center in the telost brain. We are investigating whether neuroendocrinological (Imidacloprid, Thiacloprid) and psychoactive pharmaceuticals (Citalopram, Lamotrigine, Orazepram) found in European waters trigger similar behavioral patterns. **Outlook:** We will dissect which chemosensory system and higher brain areas are involved in the behavioral reactions to these environmental contaminants. This will advance our understanding of the impact of chemicals on fish behavior.

**TU334 Urban sewage effluents into an alpine stream: are information on behavioural effects on Daphnia magna suitable to protect alpine cold adapted species?**

**V. Di Nica,** University of Milan - Bicocca (VAT IT12621570154) / Department of Earth and Environmental Sciences; **V. Lenicioni,** F. Bellamoli, MUSE-Museo delle Scienze; Dept. of Chem. and Tech. / University of Trento / Department of Chemistry and Environmental Sciences / Water Research Institute Italian National Research Council IRSA-CNRT / Dept. of Earth and Environmental Sciences; **C. Ferrari,** University of Milano Bicocca; **S. Villa,** EMA European Medicines Agency

Even if identified as pristine, mountain freshwater ecosystems could be threatened by chemical pollutants through the discharge of effluents from wastewater treatment plants (WWTPs). In Italy, WWTPs are regularly responsible for the discharge of pharmaceuticals and personal care products have been detected in different alpine rivers downstream of WWTPs. Acute toxicity tests performed with *Daphnia magna* are among the most internationally used bioassays for monitoring the toxicity of effluents. However, acute toxicity tests do not take into consideration endpoints that may provide early warning signals about the health of the exposed populations, such as behavioral changes. Altered behavioural signals could be induced at sublethal concentrations which are significantly lower than the corresponding LC(50). In this study, we compared the sensitivity as mortality and swimming of *Daphnia magna* and *Dinaea cinerella* gr. larvae, a chironomid (Diptera Chironomidae) common in cold freshwaters in the Alps, often associated to pristine environments. Both organisms were exposed for 24 and 48 hrs to different dilutions of effluents collected from a WWTP located at the Tonale Pass locality, in Trentino (1799 m a.s.l., NE Italy). The aim was to verify if *D. magna* could be employed in bio-monitoring programs for WWTPs located in Alpine areas as surrogate of cold freshwater best adapted species. Mortality rate and behavioural responses (as swimming, analysed with two video tracking systems: LoliTrack Systems and Imag3wrnTrck) were compared. *D. magna* was an average spent in the nicotine containing zone. In contrast, *D. cinerella* gr. reared in the exposure to undiluted samples. Exposure to serial dilutions of the effluent caused mortality only in *D. magna* (15% of mortality after 24 hrs at 1:1000 dilutions; 15% and 20% of mortality after 48 hrs at dilutions of 1:100 and 1: 1000, respectively). For the behavioural investigations, exposure to dilutions of the treated effluent induced significant alterations of swimming parameters in both organisms (e.g., the time spent in the active swimming phase and the average speed of movement and the cumulative distance travelled in both) at both the exposure times. Overall, these findings emphasised a higher sensitivity of *D. magna* than *D. cinerella* gr. to treated effluents. Accordingly, *D. magna* might be proposed as model organism to test the toxicity of WWTP effluents in alpine streams.

**TU335 Do silver and titanium dioxide nanoparticles influence the fish kairomone induced anti-predator defence in Daphnia magna?**

**A. Beasley,** University of Siegen; **S. Hartmann,** University of Siegen, Institute of Biology / Department of Chemistry and Biology; **K. Witte,** University of Siegen / Department of Chemistry and Biology

*Daphnia* possess a trait of phenotypic plasticity, whereby kairomones from fish induce growth and the formation of structures such as a spine or helmet. The resulting increase in body size, allows the daphnids to defend themselves from the predators in their natural environment. As the common link between green algae and fish in the food chain, *Daphnia* is a key component in the freshwater system. Their ability to grow adequate defensive structures, is therefore a highly relevant problem in modern aquatic ecosystems. *D. magna* is a promising model for tropical estuarine fish ecotoxicological studies and we focused here on its feasibility to address fish early life stage toxicity induced anti-predator responses. We tried to escape the dish. Attractive and aversive responses have been reported to be attributed to differential activity levels in the Habenula with according activation or inhibition of the reward center in the telost brain. We are investigating whether neuroendocrinological (Imidacloprid, Thiacloprid) and psychoactive pharmaceuticals (Citalopram, Lamotrigine, Orazepram) found in European waters trigger similar behavioral patterns. **Outlook:** We will dissect which chemosensory system and higher brain areas are involved in the behavioral reactions to these environmental contaminants. This will advance our understanding of the impact of chemicals on fish behavior.
are therefore of particular scientific interest, to establish what impact the MNMs are having on the freshwater cycle and food-chain. In our study, we investigate the effects of Ag (NM300K) and TiO
( NM105) MNMs on the predator defence response; by chronically exposing Daphnia magna to fish kairromones and a range of nanoparticle concentrations. This experiment was conducted in accordance with OECD guideline No. 211 over a course of 21 days. For statistical analysis, we measured the body length, body width and tail spine length after each nout and compared the results of the non-monotonic stressors on swimming in D. magna. It is taken of each daphnial at the end of the experiment, to observe and compare the microscopic details of the anti-predator defences in the treated and untreated daphnia.

TU336 Behavioral and Physiological Responses of Daphnia magna to Fluoxetine and Propanolol Exposures
M.E. Nielsen, P. Roslev, Aalborg University / Biology and Environmental Science
Fluoxetine and propanolol are neuroactive human pharmaceuticals that occur as pollutants in surface waters. The potential effect of such pharmaceuticals on aquatic organisms including invertebrates has raised some concern but many adverse effects are not well characterized. In this study, 6 physiological parameters in the freshwater Cladoceran Daphnia magna were compared for their responses to fluoxetine and propanolol exposure: mobility (dichotomous response), active swimming time, swimming distance, swimming velocity, swimming acceleration speed, and survival in the absence of food (starvation/survival). Changes in swimming behavior of D. magna were quantified by video tracking of single organisms followed by image analyses. Active swimming time and swimming distance appeared to be more responsive behavioral endpoints than swimming velocity and swimming acceleration. The EC50s for fluoxetine and propanolol determined from swimming time and swimming distance were comparable (1-2 mg/L). At low sublethal exposure concentrations (µg/L), non-monotonic responses in swimming behavior were observed in D. magna. Behavior profiling estimated from multiple behavioral parameters showed that fluoxetine and propanolol stimulate swimming activity at 1-10 µg/L. EC50 values for fluoxetine and propanolol estimated from survival time in the absence of food (starvation-survival) were much lower than EC50 values estimated from changes in swimming behavior. Starvation-survival is strongly affected by energy metabolism and we suggest that this parameter can be a potential sensitive endpoint for determining adverse effects of pharmaceuticals to D. magna. Combining behavioral and physiological responses to high and very low exposure concentrations should be considered in models predicting adverse effects of pharmaceuticals to non-target organisms.

TU337 How toxic is a non-toxic nanomaterial? Behaviour as an indicator of effect in Danio rerio (zebrafish) exposed to nanogold
T. Botha, North-West University / School of Biological Science; S. Brand, North-West University; V. Wepener, North-West University / School of Biological Sciences
Gold nanoparticles are used as drug delivery vectors based on the assumption that they have a low toxicity. Literature has however showed conflicting results over the last few years. This study aimed at investigating the toxicological effects of nanogold (nAu) over a range of indicators from sub cellular to whole organism level. Gene regulation, changes in oxidative stress biomarkers and swimming performance were assessed in Danio rerio (zebrafish) following exposures to nAu. Adult zebrafish were exposed to nAu for 96 hours. Swimming performance was measured post exposure. Liver tissue was collected for DNA microarray and Real Time Polymerase Chain Reactions (RT-PCR) analyses to determine changes in gene expression (catalase, superoxide dismutase and metallothioneins). Whole body samples were stored in respective buffers for protein biomarker analysis (catalase, superoxide dismutase, acetylcholine esterase, malondialdehyde, cellular energy allocation and metallothionein). Swimming behaviour was assessed in 1.1 L swimming tunnel, briefly fish were acclimatized within the chamber for one hour. After acclimatisation the animals were fed on alternate days with control food or food impregnated with AgCl or AgNP (approximately 200 mg kg^-1) during 7, 14 and 28 days. The movements of the amiphipods were tracked using a DanioVision™ system with EthoVision®XTR software for behavioural analysis under 3 minutes dark/3 minutes light cycle. Differences in velocity of swimming, response to light and thigmotaxis were evaluated. In the Ag exposure via water, light significantly increased maximum velocity for all treatments (p<0.05) indicating an escape-related behaviour; excepting at 100 µg L^-1, where the maximum velocity had no difference between lights off and on (p=0.10), showing that silver at this concentration had a significant effect on the response to light; no significant effects were observed in frequency in centre zone for all treatments (p>0.05), although, cumulative duration in centre zone was significantly reduced with 25 µg L^-1 AgCl; however, where animals spent more time in the centre zone when was dark. Results from the exposure via food are currently undergoing analysis. The current results indicate that silver has effects on swimming and response to light behaviours in E. marinus, indicating that exposed animals in the environment could be more vulnerable to predation. Acknowledgement: The authors thank São Paulo Research Foundation (FAPESP 2016/1963-4) for financial support. We also thank Professor Dr. Theodore Henry from Heriot-Watt University for providing the food (control, AgCl and AgNP) used in the feeding exposure.

TU338 Developing methods to determine aquatic invertebrate behavioural endpoints for regulatory ecotoxicology studies
Under current plant protection product (PPP) regulation, Tier I aquatic ecotoxicology studies measure mortality (acute) or reproduction (chronic). For invertebrates, these parameters are used to address the current protection goals of maintaining populations. Agreed guidelines for reproduction studies for aquatic invertebrates is currently under review for low and very low exposure concentrations. However, for some substances, other taxa/species may potentially be more sensitive e.g. Ephemeroptera, Plecoptera, Trichoptera (EPT) species. Currently, there are no agreed methods for measuring reproduction endpoints for non-standard test species, such as EPT species. EPT species often live as larvae for a prolonged period and have an aerial adult stage, and thus assessing reproductive endpoints from a full life cycle is not feasible. Therefore, a Tier II approach is desirable for these endpoints. The authors developed a new Tier II approach to the reproductive effects is desirable. Although behavioural endpoints (e.g. predator response, locomotion, feeding activity) do not directly relate to the protection goals of maintaining populations, they may still have a useful role in regulatory risk assessment. For example, for organophosphates (OPs) with steep dose-response curves and a narrow exposure window between acute and chronic effects, significant differences on reproduction can be due to mortality of adults rather than true reproductive effects; therefore, designing specific reproduction studies for e.g. EPT species may not be necessary for such substances. Instead, if a risk assessment were undertaken using acute and behavioural endpoints and acceptable risks were concluded, then it would be unlikely for effects at the population level to arise. Here we have tested our experimental Assessing aquatic invertebrate behavioural endpoints in one standard (Daphnia magna) and two non-standard (EPT: mayfly, caddis)/test species that are suitable for use in regulatory toxicity tests, integrating the regulatory needs with the practicalities of ecotoxicology testing.

TU340 The effects of sublethal doses of pollutants on crop pest, Spodoptera littoralis
D. SIAUSSAT; Institute of Ecology and Environmental Sciences / Institute of Ecology and Environmental Sciences
Pesticides have long been used as the main solution to limit agricultural pests but their widespread use resulted in chronic or diffuse environmental pollutants, development of insect resistances and biodiversity reduction. The effects of low residual doses of these chemical products on organisms that affect both targeted species (crop pests) but also beneficial insects became a major concern, particularly because low doses of pesticides can induce various effects. In addition to the negative effects, some studies highlighted unexpected positive - also called
hormetic effects on insects, leading to surges in pest population growth at greater rate than what would have been observed without pesticide application. The present study aimed to examine the effects of sublethal doses of various representative products of large pesticide families used against a major pest insect, the cotton leafworm Spodoptera littoralis, and known to present a residual activity and persistence in the environment. Using an integrated approach from genes to behavior, we analyzed the impact of fluorine systems and their adsorption on the sexual or feeding behavior of our crop pest model following application of sublethal doses of delta-aminiterin, methomyl and chlorpyrifos. Whereas sublethal doses of methomyl appeared to disrupt the feeding behavior of larvae, we demonstrated a hormetic response of males to sublethal dose of deltaaminiterin. We completed our study by molecular (qPCR), biochemical (proteomic, AChE activity and metabolite) and electrophysiological approaches in order to decrypt the involved mechanism in pesticide response as well as in the behavioral disruption.

TU341

The effect of copper nanoparticleson olfaction in rainbow trout (Oncorhyncus mykiss)
P. Scalarmondino, University of Lethbridge / Department of Biological Sciences; E. Mohaddes, University of Lethbridge; E. Lari, G.G. Pyle, University of Lethbridge / Biological Sciences
Fish rely on olfaction for their survival, growth, and reproduction. Impairment of olfactory function can pose a threat to fish survival on the small scale and population loss on the larger scale. Metal contaminants (e.g., copper) can impair fish olfaction. Although the copper concentration has a direct effect on olfactory performance, it is less clear whether an exposure to CuO nanoparticles (CuNPs) on fish olfactory systems has not been well determined. The objective of this study was to investigate time-dependent effects of CuNPs and CuO on olfactory acuity and olfactory-mediated behaviours of rainbow trout. To establish CuNPs or CuO-induced olfactory-impairment thresholds, inhibitory concentration (IC) curves were determined. Fish were exposed to a geometric dilution series of CuNPs or CuO for 24 hours, and fish olfactory acuity was measured using electro-olfactography (EOG). Afterwards, fish were exposed to CuNPs or CuO at concentrations known to impair olfaction by 50% (322 and 6.8 µg/L for CuNPs and CuO, respectively) for a 24 h or 96 h exposure period. The response of fish to a social cue (taurhoeotic acid) was studied using EOG and a choice maze behavioural assay. After the behavioural experiment, fish olfactory rosettes were dissected to investigate if there was any DNA fragmentation as a marker of apoptosis that might be induced by CuNPs or CuO. Results of EOG revealed that while a 96 h exposure to CuNPs caused a significantly greater impairment of fish olfactory function relative to a 24 h exposure to the same concentration, fish olfactory acuity partially recovered after 96 h. No continuous CuO exposure to the social cue supported the results of neurophysiological experiments. Although fish exposed to control water or CuO for 96 h had an avoidance response to an alarm cue, those exposed to the CuNPs did not respond to the alarm cue. Results of DNA fragmentation indicated apoptosis was not the mechanism of olfactory toxicity for CuNPs or CuO in the exposed fish. In summary, over the same exposure periods, CuNPs appeared to impair olfactory function to a greater degree than CuO. This study extends knowledge of the impact of partial olfactory recovery was documented for continuous CuO exposure. However, the mechanism of olfactory toxicity caused by CuNPs is not clear and needs further investigation.

Informed substitution of hazardous chemicals for circular economy: science and practice (P)

TU342

Perfluoroalkyl acids concentrations in liquid wastes: a survey campaign and implications for waste disposal
M. Peruzzo, Eurolab; M. Polesello, Water Research Institute - Italian National Research Council IRSA-CNR; A. Scalco, Eurolab; S. Polesello, Water Research Institute- CNR / Water Research Institute
A survey campaign has been carried out to determine the concentrations of twelve perfluorooalkyl acids (PFAA) in liquid wastes, before the disposal in dumpsite or incinerator. The common characteristic of these wastes was that they were classified as "wastes without dangerous substances" and could be disposed of without specific treatments. Waste samples (about 120) came from solid waste treatment plants, drinking water and isolated sewage treatment plants, landfill leachate, solid waste storage facilities, car washing, septic tanks, laundry sludge and wastes from various industrial plants such as paper, food, wood, furniture, glass and pharmaceutical industries. The large spectrum of activities allows us to get a panorama of the diffusion of PFAA in the economic sectors and to evaluate the impact of the different sources. The percentage of samples which presented total PFAA concentrations greater than 1 µg/L was 65%. The maximum concentration measured was 900 µg/L. As regards the single congeners, the percentage of positive samples (i.e. > 0.05 µg/L) ranged from 5% to 37.5% for the different compounds. It is very important to note that PFOA and PFOS were found only in 5% of the samples, while the highest findings were for PFBA (57%) and PFBS (37.5%), highlighting the increasing diffusion of short chain PFAAs respect to the already restricted C8-PFAs. It is also interesting to note that one of the samples with the highest concentrations was a found in the pharmaceutical industry, and it was an aqueous washing solution of water ligurs. The overall survey undermines the need for a more accurate characterisation of wastes and the risk of transferring PFAA pollution from production sites to disposal sites, which can be located also in no-impacted areas.

TU343

Regenerated Textile raw materials: chemical contamination for LCA
A. Franchi,uzzi Laboratorio Analisi
It’s essential, for every actor involved in the supply chain of a textile company, to increase awareness that a regenerated material requires proper and specific evaluation standards. These should ensure compliance with private protocols and mandatory laws and also consider the Environmental Impact. CID (Italian Consortium for Detox Implementation) with the support of local actors (chemical laboratories) made a study concerning chemical contamination of regenerated materials in order to propose a PRSL (Product Restricted Substance List) for regenerated and recycled textile materials. The adoption of a PRSL for regenerated textiles would guarantee the safe re-use of these materials as an alternative to their disposal. This case study takes into account regenerated woolen textiles (high wool content >70%) derived by post-consumes materials (knitted apparel, apparel made up by carded woven and combed woven), pre-consumes materials (combed and carded woven, knitted fabrics, spinning and twisting trimmings), and regenerated cotton-type materials (derived from denim recycling).

Operational plan involved quantitative and qualitative assessment concerning: the evaluation of the analytical methods for the determination of the substances: APEOS (Ethoxylated Alkylphenols), Aromatic amines from azo-colorants, Chlorophenols, PFC (per-fluorinated compounds), Allergenic and Carcinogenic Dyes, Heavy metals from artificial perspiration solution Results was that about 150 sample were analysed and chemical contamination were found for aromatic amines (16% of total samples), APEOS (100% of samples), Chlorophenols (26 % of total samples), PFC (62% of total samples) heavy metals (82% of total samples), Allergenic and carcinogenic dyes (6% of total samples). Data analysis permits to establish a PRSL (Product Restricted Substance List) protocol for regenerated raw materials with the aim to have an unique PRSL available for brands, manufacturing companies and every actor involved in the textile supply chain. The PRSL adoption could improve the recycling of textile materials as an alternative to their disposal.

TU344

Challenges for a comparative risk assessment among conventional hazardous substances and alternatives for textile finishing.
N. Fuentes, J. Damasio, V. Gonzalez-Andres, M. Díez-Oritz, G. Janer, Leitat Technological Center
Both the chemicals used in textile finishing processes are known to be toxic, persistent and bioaccumulative. Indeed, some of them (e.g., PFOA and DecaBDE) are listed in the Authorisation list and will be restricted after the sunset date. Alternative products are currently proposed by chemical companies for textile applications. Here we present two case studies (FLAREX and MIDWOR projects) focusing on the substitution of hazardous substances used as Flame Retardants (Penta and Deca Durs) and Durable Water Repellents (DWRs). FRs are added to fabrics to inhibit the combustion process, and typically are products with a chemistry based on halogenates. DWRs are added to fabrics to repel water, oil and dirt, and typically are products with a chemistry based on long chain fluorocarbon polymers. These projects aim to support industry in the selection of alternatives. Alternative finishing additives available on the market were selected for laboratory validation of technical performance and industrial demonstration. In addition, a comparative risk assessment of conventional and these alternative formulations should be provided to ensure the reduction of environmental and human health impacts. One of the main challenges for a comparative risk assessment of these products is that the active substances in most of them are polymers and therefore are not subject to registration under REACH regulation. The potential human health and environmental impacts of these materials are related to their content or possible release of monomers (both with limited information). Moreover, the commercial formulations offered by chemical companies do not provide detailed composition. In fact, in the commercial products evaluated the chemical identity of the active substance was not reported in the safety data sheet. This is due to the lack of obligation to report ingredients from ancient to modern classification of the mixture. Under this scenario, we propose to base the comparative risk assessment on the toxicological profile of the chemical family of corresponding monomers (based on the information supplied by the providers), and the operational conditions necessary for the application of each of the products (assuming that the risk mitigation measures will not change within an industrial setting). The results will support industry to select functional and safer alternatives.

TU345

Substitution of firefighting foams containing per- and polyfluorinated alkyl }

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SETAC Europe 28th Annual Meeting Abstract Book
substances (PFASs)
A. Biegel-Engler, German Environment Agency - UBA / Chemicals; L. Viecke, C. Staude, German Environment Agency / Chemicals
Per-and polyfluorinated alkyl substances (PFASs) are heat resistant and show a low friction resistance. Because of these properties PFASs are for example widely used in aqueous film forming firefighting foams (AFFF). PFASs are not degradeable in the environment. This can cause a build-up of AFFF into the environment causes a contamination. Some common PFASs (such as PFOS and PFOA) need years to leach from top soil layers into the groundwater or into surface water. Short chain PFASs however reach ground water resources much faster due to their mobility in soil. These contaminations already caused closed drinking water wells. Remediation is costly and long lasting. Although fluorine free foams are available and used at several European airports many firefighters hesitate to use them instead of AFFF. Restriction and authorization are regulatory measures under REACH which can be used to minimise releases of PFASs into the environment. An international regulation via the Stockholm Convention is possible as well. In addition the dialogue with stakeholders can lead to voluntary actions and may be an alternative measure to reduce environmental releases. Scientists and manufacturers need to be encouraged to develop environmentally friendly firefighting agents without fluorinated chemicals. Moreover, scientists, authors and NGOs need to bring together knowledge about the new substances, such as analytical methods, and information on their fate and behaviour in the environment. This presentations provides an overview on regulatory actions regarding PFASs in the EU and further ideas how to substitute firefighting foams containing PFASs.

TU346
The Paradigm of Substitution - expand your view
M. Zimmer, ZVO e.V.; M. Metzner, Fraunhofer Gesellschaft
Many people mention substitution as the most promising option for risk reduction in the field of SVHCs. But it has to be considered that technical solutions are embedded into complex structure-effect relationships along of equally complexity. Many different properties and outcomes have to be considered. Otherwise a thorough assessment of the applicability of an assumed alternative will fail. The surface treatment sector as a major cross-sectional community of service providers has long term experience with innovation and substitution suggested by different players for many different reasons – risk reduction being one of them. In particular the SMEs have been constantly confronted with lots of different ideas and approaches. Hence they have deep insight into unexpected side effects and regrettable outcomes. And they are able to give indicators for real promising and applicable approaches to substitution. The authors will present some significant examples of substitution attempts – and they discuss arguments why they might be considered successful – or not.

TU347
A pilot case on how Socio-Economic Evidence can inform Risk Management decision making to assess Substitution versus Recycling for non-ferrous metals slags in safe use applications
H. Waerentschou, M. vander Straeten, Eurometaux
The implementation of the European Circular Economy policy leads to more recycling, including closing the loop on substances. This policy combined with the increasing complexity of articles leads to increasing amounts of hazardous substances and impurities being available for recycling or reuse. Recycling processes in the metals sector produce besides pure substances for safe reuse, also final slags that collect some of the impurities that cannot be recovered at economically favourable conditions. In parallel, the human health and environmental effects data generated by EU REACH and CLP Regulations lead to increasing hazard identifications and harmonised hazard classifications. Hazard endpoints of Very High Concern like CMR (carcinogens, mutagens and reproductive toxicity) or respiratory sensitisation may trigger substitution-based Risk Management Measures but also reduce the reuse in safe applications for “precautionary reasons”. In such cases, socio-economic evidence may be helpful to assess costs and benefits from a broader perspective, including Circular Economy and carbon footprint considerations.

A pilot study conducted at a non-ferrous plant specialised in the recycling of complex end-of-life articles and materials allowed to evaluate this impact and develop a tool for assessors to check how to what extent a change at a relevant hazard classification could impact the reuse capacity of final slags. The tool allows metal companies to assess their situation in respect to Substitution (materials loss or disposal) versus Reuse in safe applications.

Developments in the ecological and human health risk assessment of biopesticides: microorganisms, semiochemicals and botanicals (P)

TU348
Ecotoxicology of the hydrolate byproduct of three biopesticides on the soil environment
M. Perotti, San Jorge University / Facultad ciencias de la salud; D. Ballestero, J. Val, San Jorge University; E. Sánchez, Colegio internacional Anfora; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; M. Piñol, Jorge University / Facultad ciencias de la salud; A.M. Mainer, Universidad de Zaragoza
Synthetic pesticides have been widely used in intensive production systems throughout most of the 20th century. However in the last decades, environmental and human health concerns demand safer substances, so research on biopesticides has been increased. Although a large number of studies have been published focusing on the biological activity of biopesticides on target organisms, studies regarding toxicological effects on non-target organisms, are scarce. The BIOCROP Project (Biopesticide development by chemical and biotechnological tools) has allowed the screening of several plant extracts for bio-activity against a selected set of crop pests and arthropod vectors. Some of these compounds have showed its effective value as biopesticides. The extracts will be optimized by means of traditional and supercritical CO₂ technologies, as well as microbiological transformations. In the extraction process the organic and the aqueous fraction (hydrolates) have been separated. The hydrolates showed active compounds, being capable to act as biopesticides. In order to exclude a negative effect on the environment, these products should be studied on non-target organisms. The aim of this study was to measure the acute ecotoxicity of hydrolates obtained of the semi industrial vapor-pressure essential oil extraction of three selected aromatic plant species; a domesticated Artemisia ablowithium (Teresa, Spain), Dittrichia graveolens (Ciudad Real, Spain), and an experimentally pre-domesticated Lavandula lauiieri (Toledo, Spain) using the algae Chlamydomonas reinhardtii as aquatic model organism. Results indicate that all of three extracts having biopesticide activity are likely to cause toxic effects on the photosynthesis of Chlamydomonas reinhardtii, being Lavandula lauiieri the most toxic compound followed by Artemisia ablowithium with a very similar toxicity and Dittrichia graveolens. Consequently, the aim of this study is to evaluate the acute ecotoxicity of the hydrolate obtained from Artemisia ablowithium (Ejea, Aragón) by the traditional method of steam distillation on two organisms widely used as indicators of ecotoxicity: the freshwater crustacean Daphnia magna and the marine bacterium Vibrio fischeri. Both tests are standardized for the purpose of determining the toxicity expressed as EC₅₀. Our results indicate that the hydrolate of Artemisia ablowithium is likely to cause toxic effects on D. Magna and V. Fisheki but only high dilutions (LC50 values in the range of 0,5% in both cases). These results allow us to know the possible environmental effect that these promising plant extracts can cause as a source of cosmetic and pharmaceutical applications with the aim of ensuring more environment-friendly processes and products. Acknowledgements: We thank J. Burredillo for his generous cession of the extracts used in this study and the financial support of MINECO-FEDER (CTQ2015-64049-C3-2-R)

TU349
Ecotoxicological evaluation of the hydrolate byproduct of Satureja montana on Daphnia magna and Vibrio fischeri
E. Oliva, Universidad San Jorge; E. Terrado, San Jorge University; J. Navarro, Centro de Investigacion y Tecnologia Agroalimentaria de Aragon (CITA); M. Pinto, San Jorge University / Facultad ciencias de la salud; A.M. Mainer, Universidad de Zaragoza; D. Ballesierro, San Jorge University
The increasing demand of natural biopesticides for cosmetic use, food or phytotherapy is based on the awareness about adverse effects on health and the environment. In particular, this work is focused on the plant Satureja montana (Lamiaeae), which has demonstrated a wide range of applications due to its important antioxidant and antimicrobial activities. Furthermore, an group of compounds known as sesquiterpens have a sweet flavor and simple cultivation characteristics. The main components, thymol and carvacrol (oxygenated monoterpenes), are supposed to be responsible for these biological activities. Although there are a substantial number of studies where Satureja specieas evaluated for their biological and pharmacological activities, as well as their chemical characterization, limited data are available on ecotoxicological characterizations. Consequently, the aim of this study is to evaluate the acute ecotoxicity of the hydrolate obtained from Satureja montana (Ejea, Aragón) by the traditional method of steam distillation on two organisms widely used as indicators of ecotoxicity: the freshwater crustacean Daphnia magna and the marine bacterium Vibrio fischeri. Both tests are standardized for the purpose of determining the toxicity expressed as EC₅₀. Our results indicate that the hydrolate of Satureja montana is likely to cause toxic effects on D. Magna and V. Fisheki but only high dilutions (LC50 values in the range of 0,5% in both cases). These results allow us to know the possible environmental effect that these promising plant extracts can cause as a source of cosmetic and pharmaceutical applications with the aim of ensuring more environment-friendly processes and products. Acknowledgements: We thank J. Burredillo, for his generous cession of the extracts used in this study and the financial support of MINECO-FEDER (CTQ2015-64049-C3-2-R)

TU350
The impact of the hydrolate byproduct of three biopesticides on the soil environment
M. Perotti, San Jorge University / Facultad ciencias de la salud; D. Ballestero, J. Val, San Jorge University; E. Sánchez, Colegio internacional Anfora; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; J. Urieta, Universidad de Zaragoza
The extended use of synthetic pesticides has resulted, during the last century, in the pollution of the agricultural soil environments. As an alternative to these products environmentally friendly biopesticides are, nowadays, being developed. Although biological activity of biopesticides on target organisms is well known, studies focusing on the effects on soil non-target organisms are scarce. The BIOCROP Project (Biopesticide development by chemical and biotechnological tools) has focused on the production and optimization of plant/fungal/agri-waste-based crop protectants via cultivation techniques, biotransformation, selective extraction and separations by traditional and supercritical CO₂ technologies. In the traditional extraction process the organic and the aqueous fraction (hydrolate) have been separated. Both of them showed active compounds capable to act as biopesticides. In order to exclude a negative effect on the environment, these products were tested
on soil non-target organisms (microbial community and earthworms). Soil microbial communities from an ecological farming crop have been exposed to three hydrocarbons, obtained by semi industrial vapor-pressure essential oil extraction, from three aromatic plant species: Artemisia absinthium, Ditrichia graveolens and Lavandula latifolia. The effects on the microbial community have been assessed using the community-level physiological profile – CLPP. This method relies on the ability of the natural bacterial community for degrading different carbon sources present in Biolog Ecoplates®. The acute toxicity of hydrocarbons was also tested by Eisenia fetida bioassay. Results indicate that hydrocarbons caused acute adverse effects in E. fetida, in particular D. graveolens and A. latifolia (LC50 in the range of dilution of 10-2). All three bioprecipitates provoked changes in the soil microbial ability to degrade different carbon sources compared to control. These results allow for a better understanding of the impacts of natural crop protectants in the soil environment as a pest management alternative. Acknowledgements: We thank J. Buriló and J. Navarro for his generous cession of the extracts used in this study and the financial support of MINECO-FEDER (CTQ2015-64049-C3-2-R).

TU351
Acute toxicity of emulsifiable concentrate of Alpinia galangal essential oil against Cyprinus carpio
H. Kim, K. Kim, H. Jeon, Y. Choi, Y. Kim, S. Lee. Kyungpook National University

Essential oils have exhibited their fumigational and topical toxicities on insect pests and they are developed as safe biopesticides. However, their use may be caused potent toxic effects to non-target organisms in the environment. It needs to be determined their ecotoxicological effects on non-target organisms in the environment. Alpinia galangal essential oil (AGEO) has been considered to control the outbreak insect pest, Ricina sp. in South Korea. Acute toxicities of AGEO against Cyprinus carpio were assessed to understand its possible toxic effect on the representative aquatic organism. Cyprinus carpio in a static condition followed by OECD guideline 203 in 5 l beakers. As AGEOs were formulated for emulsifiable concentrate (EC) as an active ingredient, they were mixed with ethanol and surfactant in a ratio of 5:4:1. Tergitol is a surfactant and it did not show any toxic effect on the fish, so that it was used for the formulation of emulsifiable concentrate for AGEO. Three different AGEOs were prepared according to their extraction methods as steam distillation, solvent extraction and supercritical fluid extraction. After the EC formulation was prepared, they were ready to expose to C. carpio to determine LC50 values. All emulsifiable concentrates of three different AGEO showed no mortality on the tested fish during 96-hour incubation. Therefore, 48h-LC50 values for the VFEO were under the toxicity criteria of level 3 for the pesticide to C. carpio standardized by Korea Rural Development Administration. Based on these results, AGEO can be considered to use as a natural insecticide.

TU352
Chronic toxicity of emulsifiable concentrate of cinnamon essential oils against Cyprinus carpio
H. Jeon, K. Kim, H. Kim, Y. Choi, S. Lee. Kyungpook National University

Recently, many researchers have developed natural insecticides to control insect pests by using plant essential oils (EOs) due to their eco-friendly safe properties. Cinnamon EO is one of important EOs to be a potent candidate and is formulated as an emulsifiable concentrate (EC). As its use is recognized as safe, it needs to be determined its negative effect on the environment using bioindicators. To evaluate the negative effect on the ecosystem, chronic effects of cinnamon EOEC against Cyprinus carpio was determined in a static condition for 40 days. When cinnamon EOEC was administered, they were mixed with ethanol and tergitol as surfactants. To select an appropriate surfactants, 8 different types of surfactants (Tween 80, Sodium dodecyl sulfate (SDS), Nonident, Triton X-100, Sodium dodecyl Benzene Sulfonate (SDBS), Koliphor, Tergitol and Mixture of SDBS and Nonident) were tested for the formulation and tergitol showed the lowest toxicity to the fish in an acute toxicity test. With the result of the acute toxicity of cinnamon EOEC, chronic toxicities of cinnamon EOEC was determined at 5 different concentrations for 40 days. Each concentration was triplicate exposed to 10 of C. carpio adults. The treated five concentrations were 0.08, 0.16, 0.64, 2.56, and 5.12 ppm and the mean survival rate was 8.48 ± 0.47. The survival rate of the 10 of different concentrations for 40 days. Each conce...
plasticizers. Our results indicate that participants are exposed to various FRs and plasticizers through their daily household environment. The Canadian adults' external exposure of hands to FRs and plasticizers were related to the levels in their household electronic products, particularly handheld devices such as cell phones. Handheld devices could contribute to human exposure through direct contact during use while large and stationary electronic products could be important sources and sinks in household environment.

TU355 Modelling diffuse emissions and fate of engineered nanoparticles used in outdoor paints to urban surface waters at high spatial and temporal resolution
M.D. Nuñez, University of York / Environment; A. Pratautorius, University of Victoria / Department of Environmental Geosciences; A. Boxall, University of York / Environment Department

The expansion of the nanotechnology sector is leading to an increased use of products containing engineered nanoparticles (ENPs) in outdoor urban environments. Outdoor materials, such as construction materials, paints and coatings, are subject to weathering and ageing processes and will consequently lead to emissions of ENPs to the surrounding environment over time. Data on measured environmental exposure concentrations are still lacking for ENPs. Until analytical and monitoring techniques for ENPs in environmental matrices become available, modelling tools are the best approach to estimate exposure levels. Furthermore, models can analyze a wide range of potential scenarios and predict possible future trends of urban exposure which cannot be achieved by monitoring. In this study we propose a model based on the Sciences and Convergent Technology that combines an emission and a fate model for ENPs with high spatial and temporal resolution for an urban environment. The model was applied to the study of titanium dioxide (TiO2) ENP emissions when incorporated in outdoor paints in the city of York (UK). The model emission calculations are based on locally collected data on outdoor paint usage (outdoor paint application ratios and frequency of application for York) and information about the sewage network connectivity around the city. Reliable and official sources of information, such as Yorkshire Water and York City Council, and surface water characteristics acquired from an extensive and local monitoring campaign performed in the rivers Ouse and Foss, helped to parametrize the river fate model. Using the model, the transport and fate of TiO2 ENPs, the rivers circulating within the city (the Ouse and the Foss) could be studied and spatially resolved results obtained. The identification of hot spots of emissions within the city and the study of ENP transport and fate are accomplished by this approach.

TU356 Occurrence and human exposure of parabens, triclosan and triclocarban in personal care products from Korea
S. Mok, Hanyang University / Marine Sciences and Convergent Technology; J. Lim, Hanyang University; M. Lim, Seoul National University / Environmental Health Sciences; J. Park, Seoul National University / Environmental Health Science; K. Lee, Seoul National University, Graduate School of Public Health; H. Moon, Hanyang University / Marine Sciences and Convergent Technology; K. Lee, Seoul National University / Environmental Health Sciences; J. Park, Seoul National University, Graduate School of Public Health; H. Moon, Hanyang University / Marine Sciences and Convergent Technology

Parabens (p-hydroxybenzoic acid esters), triclosan (TCS) and triclocarban (TCC) have been extensively used in various cosmetics and personal care products (CPPCs) as preservatives due to their antimicrobial activities. However, little is known about the occurrence and exposure levels of parabens, TCS and TCC associated with the consumption of CPPCs in our daily life. In this study, ten parabens, four TCS and three TCC metabolites, TCS and TCC were measured in 243 CPPCs, which comprised of leave-on products (n=157), rinse-off products (n=59) and baby care products (n=31), collected from Korean market during 2016-2017, using liquid chromatography-tandem mass spectrometry (LC-MS/MS). Among ten parabens, methyl paraben (MeP) showed the highest detection rate (57%), followed by propyl paraben (PP, 49%) and butyl paraben (BuP, 41%). TCS had only 20% of detection rate and TCC was rarely detected in the samples. Total concentration of parabens widely varied with ranging from < LOQ to 10200 µg/g. Concentrations of TCS and TCC ranged from < LOQ to 340 ng/g and < LOQ to 14.0 ng/g, respectively. Higher concentrations of parabens (~ 1000 µg/g) were found at skin cares, sunscreen, face cleanser, eyeliner, body/hand lotions and lipstick. The daily exposure levels of parabens were associated with the consumption of CPPCs. The daily exposure factors, obtained from questionnaire-based survey and previous studies, and concentrations measured in our study. The mean daily exposure levels of parabens were 16.2 and 0.14 µg/kg body weight/day for mothers and their infants of Korea, respectively. Among CPPCs, some leave-on products such as skin cares, body/hand lotions, and sunscreens were the major contributors (~ 80%) to total exposure levels of total parabens.

TU357 Characteristics of exposure factors for cosmetic products in Korean infant and caregivers pair
K. Lee, Seoul National University, Graduate School of Public Health; M. Lim, Seoul National University / Environmental Health Sciences; J. Park, Seoul National University / Environmental Health Science

Concerns about potential health risks of chemicals in consumer products like cosmetic, personal care products, food containers are growing. Especially infant and children are more vulnerable to chemical exposure compared to adults. Since exposure to these chemicals could be determined by consumer products usage pattern, an accurate measurement of the usage patterns of consumer products is important for realistic exposure assessment. The aims of this study were to determine exposure factors of consumer products for child and mother and analyze the relationship between consumer exposures of caregiver and infant. We determined the exposure factors of 12 kinds of cosmetics (3 basic cosmetics, 1 UV protection products, 3 hair products, 3 body products and 2 cleaning products) for adults and 10 kinds of consumer products (2 cosmetics, 3 oral supplies and 7 household products) for children and 11 kinds of food containers for household. Survey was conducted on 505 mother-infant pairs from Oct. to Dec. 2015 in Seoul metropolitan area by a structured questionnaire. The number of subjects were determined by proportioning based on the composition ratio in children’s sex and age distribution from 0 to 4. All cosmetics investigated in this study were used on a daily basis and usage rates from 52.1% to 98.0%, except 9.9% for hair styling product and 7.7% for deodorant. The frequency of food intake by food containers ranged 2.52 to 17.39 times a month. The use of children's oral supplies varies according to the age of the child. There were a significant difference in the mother’s usage rates of lotion, hair products and vinyl package food by age of children. These exposure factor characteristics could be useful input data for exposure risk and assessment for chemical regulation.

TU358 Analysis of metabolites of organophosphate and pyrethroid pesticides in urine from Italian children
N. Bravo, CSIC-IDAEA / Department of Environmental Chemistry; J. Grimalt, Institute of Environmental Assessment and Water Research IDAEA CSIC / Department of Environmental Chemistry; B. Bocca, G. Calamandrei, A. Alimonti, Istituto Superiore di Sanità Organophosphate (OP) and pyrethroid (PYR) pesticides are commonly used in agriculture, domestic environments and gardening. They eliminate insects because of their strong potential to disrupt the brain and nervous system of these organisms. Unfortunately, this neurotoxic effect is not selective enough as to avoid potential damage to other non-target species, including humans. OP and PYR pesticide exposure has been related to several human health effects, including respiratory, digestive, productive and neurological problems, among others. Children are more vulnerable than adults to environmental pollutant exposure because their organs and metabolism is still under development. Thus, their detoxification mechanisms are not yet mature. Once in the human body, OP and PYR pesticides are typically metabolized and excreted in urine within 4-48 hours after exposure, depending on the compound. Organophosphates are metabolized into dialkyl phosphates (DAPs) and inorganic phosphate (Pi), such as diethylaminoethyl phosphoric acid (TCPY, metabolite of chlorpyriphos), 4-nitrophenol (PNP, metabolite of parathion), malathion dicarboxylic acid (MDA, metabolite of malathione), 3-chloro-4-methyl-7-hydroxycumarin (CMHC, metabolite of coumaphos), 2-isopropyl-6-methyl-4-pirimidyl (IMPY, metabolite of diazinon) and 2-dimethylamino-6-methyl pyrimidin-4-ol (DEAMYP, metabolite of pirimiphos). Concerning pyrethroids, most compounds such as permethrin, cypermethrin, deltamethrin, allethrin, resmethrin and fenvalerate are metabolized into one single compound, 3-phenoxybenzoic acid (3-PBA). On the other hand, cyfluthrin is metabolized into 4-fluoro-3-phenoxybenzoic acid (4-F-3-PBA). Therefore, 3-PBA and 4-F-3-PBA can be used as biomarkers of the most common PYR pesticides. The determination of the above mentioned compounds was performed using liquid chromatography-tandem mass spectrometry (LC-MS/MS). Human urine samples (n=199) from Italian children at 7 years were analyzed. Neuropsychological and psychomotor development of the children was assessed at 18-40 months by using the BAYLEY scales. In addition, neuropsychological development and intelligence were assessed at 7 years by using the NEPSY-II and the WISC, respectively. The compounds detected the most were DEAMYP (98%), PNP (97%), 3-PBA (91%) and TCPY (87%). The metabolite showing the highest concentration was DEAMYP with a median of 3.0 ng/mL followed by PNP, 3-PBA and TCPY with medians of 1.3, 0.56 and 0.47 ng/mL, respectively.

TU359 PAH levels in parturient and newborns from Aveiro region, Portugal
M. Montero, Aveiro University / Biology; M. Fraga, Biology Department CESAM Aveiro University; C. Gravato, Faculdade Ciências da Universidade de Lisboa / department of Biology & CESAM; C.J. Silva, University of Aveiro / Biology Department & CESAM; A.L. Machado, University of Aveiro / CESAM Department of Biology; A.M. Soares, University of Aveiro / department of Biology & CESAM; S. Loureiro, Universidad de Aveiro / Biology

Environmental exposure to humans may be critical in some residential and working areas, and therefore biomarkers can and should be used as early warning tools to depict exposure and evaluate effects. Polycyclic aromatic hydrocarbons (PAHs) are a group of priority chemicals to be studied and monitored as they are considered carcinogenic and teratogenic. In the present study we aimed to monitor human fetal exposure to PAHs by measuring concentrations of naphthalene, phenanthrene, pyrene and BaP equivalents in placenta, umbilical cord and mother’s blood (plasma and blood cells) of 49 parturient from Aveiro region, Portugal. Information organized in questionnaire forms, tissues and organs were collected following the
parturient consent. Levels of PAHs equivalents were measured by a fluorescence methodology and were correlated with exposure to tobacco smoke as well as with other information regarding mother’s lifestyle (e.g. urban or rural residential area, exposure to vehicles exhaust). In general, the studied group presented higher PAHs levels in the placenta and lower PAHs levels in the umbilical cord blood. The low molecular weight PAHs (naphthalene and phenanthrene) measured in placenta presented higher concentrations than high molecular weight PAHs (pyrene and benzo[a]pyrene). Moreover, increased levels of benzo[a]pyrene and phenanthrene equivalents were associated with exposure to vehicle exhaust, while higher levels of benzo[a]pyrene were associated with exposure to tobacco smoke at work. The highest naphthalene, pyrene and BaP equivalents levels were found in homogenized placenta of mothers who smoked in the third trimester of pregnancy. No significant correlations were found between PAHs levels and anthropometric data of newborns, but in general, higher PAHs levels were found in newborns groups with lower weight, head circumference, and length. Maternal-infant biomonitoring can be a major asset in evaluating environmental exposure to contaminants, which can also provide high value information for preventive medicine.

TU360 A modelling framework to link aggregate exposure pathways with internal exposures and potential bioactivity J.A. Arnott, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; J. chestenat, in ARC Arnot Research & Consulting; L. Li, University of Toronto at Scarborough / Department of Environmental Sciences; X. Zhang, University of Toronto Scarborough / School of Engineering and Applied Sciences; B. Givechhi, J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences

The aggregate exposure pathway (AEP) model is a conceptual framework to help allocate environmental information including (i) production, use and release, (ii) chemical fate and concentrations in various multimedia (urban and rural environments, biota), (iii) external exposures (e.g., contact rates), and (iv) internal exposures (e.g., blood concentrations) for human and ecological receptors. Some exposure models include elements of the AEP framework and are useful tools for organizing data, identifying chemical concentrations throughout the source-to-exposure continuum and identifying research needs to address uncertainty in chemical evaluations. We present an overview of the Risk Assessment Identification And Ranking-Indoor and Consumer Exposure (RAIDAR-ICE) modelling framework. RAIDAR-ICE includes direct and indirect near-field exposures and can include far-field exposures for aggregate human exposure assessment. The RAIDAR-ICE model is parameterized in this case study for about 200 organic chemicals comprising a broad range of chemical properties representative of commercial chemicals to demonstrate model applications for exposure and risk-based prioritization. Based on assumed emissions to air in the indoor environment, intake fractions (used for ranking exposure potential) range from 0.0018 to 0.37 emphasising the relatively high potential for human exposures to chemicals entering the indoor environment and its potential to emission sources. Following the same exposure scenario, unit emission rate based whole body concentrations (exposure potential) range from 3×10^-3 to 5×10^-6 mmol/kg. The differences in ranking chemicals for exposure based on either external (intake fraction) or internal (concentration) exposure metrics are substantial due to chemical-specific differences in toxicokinetics. In absence of well-defined chemical use information, the model calculated critical emission rate can be used to gauge potential risks and provide guidance for proposed new chemical use. Using in vitro bioactivity data from the ToxCast program as an assumed “effect threshold”, the critical emission rates of the case study chemicals span approximately 8 orders of magnitude. Including estimates of actual chemical use rates allows for the calculation of risk (bioactivity)-based estimates; the results of which span 10 orders of magnitude. Recommendations for addressing uncertainty in the model and its required input parameters are presented.

TU361 ENVIRONMENTAL IMPACT OF LEAD MINING ON THE BIO-ECOSYSTEM IN ISHIAGU TOWN OF EBONYI STATE IN SOUTH-EASTERN NIGERIA S. Anika, UNIVERSITY OF NIGERIA, NSUKKA; V. Ahur, Federal University of Agriculture Makurdi / Department of Veterinary Physiology, Pharmacology and Biochemistry; P. Onyeyili, Federal University of Agriculture Makurdi / Department of Physiology Pharmacology and Biochemistry

Lead is a soft, ductile metal found naturally in the environment and accounting for 0.0016% of the earth's crust. However, due to its ubiquitous nature, it is used in several industrial processes which can result to severe environmental pollution which can pass across food chains to animals and man. In 2010, about 400 deaths especially among children in Bukkyum and Anka LGAs of Zamfara State, Nigeria, due to chronic lead toxicity were reported by Medecins Sans Frontieres. Soil, water, grasses/plants, food, fish and quarry dust were collected between March and May 2017, processed and analyzed for lead concentrations. All water samples exceeded WHO recommended safety limits for lead. Soil and food samples contained values. Sampling of Ivo River, the main communal water source showed links to upstream pollution as the river passes through lead mining fields. The result showed the negative impact of lead mining in Ishiagu and the need for regulatory agencies/government to take measures to avert consequences of lead poisoning in human beings.

TU362 Evaluation of potential risk of rare earth element contamination from leachate originating from electronic waste disposal M. Makombe, Scientific Services, Cape Town / Department of Chemistry; C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; V. S. Sciclun, C. TET / Physical sciences, Earth and Environment; R. Bargagli, University of Siena / Department of Physical Sciences, Earth and Environment

Rare Earth Elements (REEs) form critical elements required in technological applications. Their presence in electronic waste gives leads to environmental pollution. Therefore, there is a constant necessity for accurate data and reliable fast analytical methods. This review discusses and compares the methods given for the determination of rare earth elements and heavy metals in electronic waste and other associated depositions and their bioavailability in urban environments such as in fact, that dissolution and alkaline fusion are commonly employed. Various instrumental techniques that have been used recently includes electrothermal vapourizer or laser ablation accessory connected to ICP-MS or ICP-OES, X-ray Fluorescence and electro-analytical techniques. These methods of analysis including their accuracy, limit of detection (LOD) and limit of quantification (LOQ) are compared and discussed. This study further explores the potential use of nanostructured and instrumental techniques with a focus on rare earth elements in electronic waste and its disposal into the environment. Key words: Rare earth elements; electronic waste; fusion optimisation; spectrocop; wastewater

TU363 A stonework snail as a new biomonitor of metal contamination in the urban environment E. Rota, B. Braccino, R. Dei, University of Siena / Department of Physical Sciences, Earth and Environment; N. Bianchi, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Ancora, University of Siena / Department of Physical Sciences, Earth and Environment; R. Bargagli, University of Siena / Department of Physical Sciences, Earth and Environment

Papillifera papillaris (O.F. Müller) is a small pulmonate gastropod commonly dwelling on stone walls and monuments in Italian and Mediterranean urban environments. This widespread, low-vagile and omnivorous organism, which barely interacts directly with soil and inhaled fine particles, is a promising indicator of metal contamination and urban pollution and can be used in bioassays. Its low weight, head circumference, and length. No significant correlations were found between PAHs levels and anthropometric data of newborns, but in general, higher PAHs levels were found in newborns groups with lower weight, head circumference, and length. Maternal-infant biomonitoring can be a major asset in evaluating environmental exposure to contaminants, which can also provide high value information for preventive medicine.

TU364 Metals Distribution in Urban Garden Soils in Greater Victoria, BC, Canada M. Dodd, Royal Roads University / School of Environment & Sustainability

This study was conducted to determine heavy metal distribution in surface soils in Greater Victoria and common metals in house waste; Greater Victoria, BC, Canada Over 70 soil samples were collected from 190 residential and community gardens and analyzed using a portable XRF. A subset of the samples were analyzed by ICP-MS. A comparison of the XRF metal concentrations to the ICP-MS data indicated that the XRF was a suitable technique for the rapid analysis of the large number of samples collected. Elevated concentrations of metals including Pb, Cu, Cr and Zn, were found in some garden soils. Based on homeowner interviews, historical maps and archival reviews, Pb contamination was primarily attributed to the use of lead paints and housing maintenance practices. Potential sources of the other metal contaminants included the use of wood preservatives, septic fields, automotive
repair and old orchards. An interactive map of metal distribution based on the data obtained was developed and made available to the public. Metal bioavailability was assessed using an in vitro bioaccessibility assay and the data used to assess the risk associated with soil ingestion. The estimated daily intake was determined for each element incorporating metal bioaccessibility data. Using the median concentrations, the calculated EDI values were well below the respective tolerable daily intake suggested that the risk associated with ingestion of metal contaminants was minimal. Dandelion samples were also collected and analyzed as surrogate plants to determine potential metal uptake. Metal bioaccumulation factors and translocation factors for the dandelion samples also suggested that the potential for the uptake of the metals studied was low. However there were isolated gardens with elevated Pb concentrations which were identified as being of concern. Recommendations for limiting Pb exposure in these gardens were provided to the homeowner.

TU365 Soil quality analysis, a lever for identifying sources of trace elements and managing urban allotments for agricultural production M. Letragr, C. Daudin, N. Farlie, L. Caulet, UnilAquitaine, Rouen - Aglyhe Unit Projects seeking to produce home-consumption vegetables in urban areas and, more generally, to set up agricultural production inside cities, are increasingly numerous. Agglomeration and local public authorities also need references on thresholds of contamination in trace element and their transfer into plants. At European level, soil quality regulations are not homogenous; in France, the legislation is mainly based on the contents in vegetables or fruits, the link with the soil never made. Some studies have highlighted the potential risk of metal contamination of vegetables grown in urban areas and the lack of site-specific risk assessments. However, experimental trials are still lacking on the potential of using urban soil as a good substrate for producing vegetables for domestic consumption. We assessed the quality of the soil on a site in the Rouen agglomeration (Normandy, France) for three purposes: pasture, a forest recreation area and a small urban gardening area. However, the city raises questions about the future management of this last area already cultivated for many years. We have analyzed the main physicochemical characteristics of soils, the trace elements (Pb, Cu, Ni, Zn, Cd, Hg) in certain vegetables and fruits and in soils, as well as the history of agricultural practices since the sixties and the topography of the site. Transfer coefficients in consumption vegetables have also been quantified. Our results showed that the zones had a physical and chemical heterogeneity due to the effects of the different cultivation techniques used, the urbanization and the topography of the site. Some metals contents are often above the recommended limits, and soil conditions (pH = 8) significantly reduce the mobility of metals. The concentration of Pb in some of the cultivated urban samples was above limits, which makes gardening practices unsuitable for the area. Our results demonstrate that site-specific studies needed are being planned to better plan urban cropping areas, and educating urban gardeners about sustainable cropping techniques is a priority for safe feeding.

TU366 Vertical movement of PCBs in agricultural soils impacted by an historical contaminated site: using SoilPlus model to predict discharge, dynamics of movement in soil, and rhizoremidiation potential A. Di Guardo, University of Insubria / Department of Science and High Technology; G. Gaspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; E. Terzaghi, University of Insubria (Cavallasca - De Vuch & High); M. De Fenizio, University of Milan / DEFENS; F. Mapelli, University of Milan; E. Zanandari, C. Morosini, University of Insubria / DSAT; S. Armingrilla, Municipality of Brescia / Museum of Natural Sciences; V.M. Sale, S. Ameli, P. Nastasio, ERSAF Among the national priority polluted sites, the SIN Brescia Caffaro is located in a mid size city Brescia, (200,000 inhabitants) in northern Italy. The site derived from the activity of the former Caffaro s.p.a., a chemical factory among the largest of the world that operated from 1950 to 1988. In this period Caffaro production ranged from 15000 to 13000 µg/kg in the top 30 cm to about 0.6 µg/kg at 1 m depth; PCB 209 (peculiar of Caffaro production) ranged from 1500 to 13000 µg/kg in the top 30 cm, descending to about 13 µg/kg at 1 m depth. A gradient was also observed along the runoff water flow direction. These concentrations of PCBs were then used to obtain the SoilPlus model (a layered dynamic multimedia mass flux model) and used to predict discharge amounts and conditions regulating vertical movement. The objective was to reconstruct soil concentration profile during the historical contamination to predict discharged amount, potential for additional vertical movement, and conditions regulating chemical bioavailability for future PCB rhizoremidiation.

TU367 Metals and metalloids in inhalable fractions of urban road dust C.L. Wiseman, University of Toronto / School of the Environment; J. Nui, C. Levesque, P.E. Rasmussen, Health Canada Road dusts are highly enriched with transition metalloids such as Cu, Sb and Zn, due to road surface attrition and wear of automotive components. Despite the importance of road dust as a source of inhalable particles (< 10 µm), little has been published regarding elemental enrichment patterns in particle sizes relevant to inhalation exposures. The goal of this study is to evaluate the contribution of road dust to airborne particulate matter, focussing on metals and metalloids in the inhalable particle size range. Road dust samples were collected from a variety of street types in 2015-2016 in collaboration with the City of Toronto, representing a total road length of about 840 km. Two types of samples were generated by the regenerative-air sweepers: the bulk hopper debris and finer dust box samples. The 50% percentile particle size diameter of the dust box samples was determined by laser analysis to be 9.4 µm, which represents the inhalable fraction. A total of 64 samples (32 infrared and 32 bulk samples) were subjected to a 4-acid digestion (HF, HClO4, HNO3 and HCl) followed by multi-element determination using Inductively-Coupled Plasma Mass Spectrometry (ICP-MS). Results showed that the inhalable fractions of road dust were enriched with metals and metalloids relative to the bulk debris, including Cd (0.55 vs. 0.25 µg/g), Zn (649 vs. 252 µg/g), Pb (8.2 vs. 2.2 µg/g) and Pb (80 vs. 54 µg/g). The enrichment of elements of known toxicity in the inhalable fraction is of particular concern, given the bioavailability of this particle size range. Available data on the total weight of road dust collected by the City of Toronto each year, combined with the elemental concentrations of the road dust determined in the present study, provides the means to calculate annual flux estimates. For example, Pb loadings in the inhalable fraction alone are estimated to range between 70 kg/yr and 141 kg/yr, which is a significant source relative to the city’s yearly inputs of 513 kg/yr of atmospheric Pb emissions reported by industries and municipal facilities in the National Pollutant Release Inventory. This example demonstrates the importance of non-exhaust forms of traffic emissions which have not been included in emission inventories to date. Next steps will involve the collection of whole, unfraccionated road dust samples from a variety of road types for particle size distribution analyses to refine elemental loadings in each size fraction.

TU368 Sequential extraction and particle size distribution of Cd, Cu, Pb and Zn in street dust of Belgrade (Serbia) T. Djordjevic, Faculty of Technology, University of Belgrade; N. Zaric, Innovation Center of the Faculty of Technology and Metallurgy, University of Belgrade; T. Solevik Knudsen, IChTM / Department for Chemistry The aim of this study was to investigate the differences in distribution of Cd, Cu, Pb, and Zn in mobile phases extracted from different size-fractions in street dust particles from Belgrade, the Capital of Serbia. The metals investigated were chosen as being of most significant pollutants according the European Environment Agency. The street dust samples were collected in summer 2016 at three different locations. The samples were fractionated into three sizes with diameters of: < 63 µm, 63 – 250 µm, and 250 – 500 µm. From different size fractions the metals were isolated into three fractions using a modified sequential extraction procedure after Tessier (Tessier at al., 1979); adsorptive and ion-exchangeable phase (using ammonium acetate at the moderately reduced pH to remove metal complexes); exchangeable phase (using 0.1 M HCl) and organic sulphide phase (using hydrogen peroxide oxidized with nitric acid). These fractions were analysed by inductively coupled plasma optical emission spectrometry (ICP-OES) using an ICP iCAP6500 Duo-Thermo Scientific instrument. The results showed that the concentrations of the metals (based on the sum of these three fractions) were in the following order: Zn > Cu > Pb > Cd. Comparison with the German National Regulations demonstrated that the concentrations of Cu and Zn in these three fractions were lower than the maximum allowed values at some locations only, indicating serious contamination with these metals at some locations. The phase partitioning study revealed that Cu and Zn were bound mainly in the second phase. Pb and Cd were predominantly associated with the third phase while Cd was in one sample predominantly associated with the first phase. Detailed analysis of distribution of metals in different size fractions did not indicate any patterns suggesting a different origin of these metals at different locations. References: Regulations about allowed quantities of dangerous and harmful matters in soil and irrigating waters and methods about their analysis, College of Engineering and Applied Chemistry of Belgrade, No. 2359/01 (Serbian) Sequential extraction procedure for the speciation of particulate trace metals. A. Tessier, P. G. C. Campbell, and M. Bisson. Analytical Chemistry, 1979, 51 (7), pp 844–851.

TU369 "New" OPEs: isopropylated, tert-butylated and di-tert-butylated Triaryl phosphate Isomers in E-waste, House, Car and NIST SRM Dust L. Juntani, Environnement and Climate Change Canada; T.F. Rodgers, University of Toronto / Chemical Engineering and Applied Chemistry; V.H. Arrandale, Cancer Care Ontario; S. Bernstein, Environment and Climate Change Canada; J.
was more sensitive to organic substances, while the AA m
species whose concentration is very differing between the two monitored areas, OP values were scarcely dependent on the sampling site: 

Organophosphate esters (OPEs) have been measured at relatively high concentrations globally in remote to urban locations with highest levels in indoor environments. Studies of OPEs often comment that these are "new" compounds, citing their use as replacements of some now-restricted brominated flame retardants. Here, “even newer” organophosphate esters were investigated in this study of dust samples from several locations with varying site types. The sample locations and types tested here include dust from Canada (houses from Vancouver and Toronto), Turkey (homes and offices from Istanbul), and Egypt (homes, offices and cars from Cairo), dust from an e-waste facility in Toronto, Canada, and NIST house dust (SRM 2583-2585 from American homes). The new OPEs investigated include bis(2-ethylhexyl)phthalate (DEHP) and tert-butyldiethylphthalate (TBTP) and a di-tert-butylated triarylphosphate and di-tert-butylated triphenylphosphate. These compounds are used as flame retardants, but are also used in hydraulic fluids and as plasticizers. ITP is primarily used in foam and is a component of Firemaster 550 whereas TBTP is in Firemaster 600. Preliminary results indicate ITPs and TBTP levels are found in the ng/g range in these dust samples. Firemaster 550 is a newer material that is typically analyzed OPE compounds such as tris(2-butoxyethyl)phosphate (TBP), tris(2-chloroethyl)phosphate (TCEP) and tris(chloropropyl)phosphate (TCP). Even though these are new to us and only recently included on some national regulation lists, these compounds are found in NIST SRM dusts that were collected in the mid-1990s thus they have been in production and used in chemicals for many decades. These compounds are of concern because they have long range transport potential as one ITP isomer was sought and found in arctic water and sediment. A few studies have shown that humans are exposed to ITPs due to detection in wristbands and metabolites in urine. These compounds are also of concern due to their reported toxicity especially related to neurotoxic effects.

OXIDATIVE POTENTIAL OF PARTICULATE MATTER COLLECTED AT INDUSTRIAL AND URBAN SITES

g. simonetti, E. Conte, Sapienza University of Rome; c. perino, CNR Institute of Atmospheric Pollution Research; L. Massimi, Sapienza University of Rome / Environmental Biology; S. Canepari, Sapienza University of Rome / Chemistry

The scientific world is still questioning about the effects of airborne particulate matter (PM) concentration and composition on human health, and different scientific approaches have been evaluated in order to gain information about it. The measurement of oxygen demand by PM is generally considered as a predictive index of PM ability to generate reactive oxygen species (ROS) in biological organisms, and different acellular assays are currently used in literature for its determination. In this work we applied three of the most used OP assays (dithiobis(2-thiocetamidothiobenzensulfonate (TTATTP), acid ascorbic − AA, and 2,7′-dichlorofluorescin − DCFH; Fang et al., 2016, Huang et al., 2016) to PM10/PM2.5 samples and to size-segregated samples collected by a 10-stage impactor. Samples were performed at an industrial site near Ferrara (Po Valley, Italy) and at a traffic urban site in Rome (Italy). All the samples were also analysed for anion, cations, macro- and micro-elements, total organic content, elemental carbon and water-soluble organic carbon, in order to identify the relationships between OP values and PM chemical composition and dimension. Despite the very different composition of PM in the two monitored areas, OP values were scarcely dependent on the sampling site species whose concentration is very different in the two areas, such as secondary inorganic ionic species, seem to play a negligible role in the ROS generation. Each assay showed a different sensitivity towards the oxidant species: the DTT method was more sensitive to organic substances, while the AA method was more sensitive to inorganic substances. The period in microcosms was chosen according to the DTF assay revealed a greater affinity with particles in the fine mode, while AA responded mainly to particles in the coarse fraction. DCFH results appear to be driven by a competition between several factors, some increasing the response and some suppressing it. Fang, T. et al.: Oxidative Potential of Ambient Water-Soluble PM2.5 in the Southeastern United States: Contrasts in Sources and Health Associations between Ascorbic Acid (AA) and Dithiobis(2-thiocetamidothiobenzensulfonate (TTATTP) Assays. Atmos. Chem. Phys. 2016, 16, 3865-79. 10.5194/acp-16-3865-2016 Huang, W. et al: Optimization of the Measurement of Particle-Bound Reactive Oxygen Species with 2,7′-dichlorofluorescin (DCFH), Water Air Soil Pollut. 2016, 227, 164.

Fate and effects of triclosan in subtropical freshwater benthic microcosms

F. Peng, Wageningen UR; P. van den Brink, Alterna/Wageningen UR / Aquatic Ecology and Water Quality Management Group b Alterna; G. Ying, Guangzhou institute of Geochemistry Chinese Academy of Sciences; H. Selck, Roskilde University / Dept Science and Environment; D.T. Salvito, Research Institute for Fragrance Materials (RIFM) / Dept of Environmental Science; N. Diepens, Wageningen University / Aquatic Environment

Triclosan (TCS) is one of the top 10 most commonly detected organic pollutants in the aquatic environment. However, little is known about the toxicity and bioaccumulation of sediment-associated TCS. We examined the effect of sediment-associated TCS on the snail, Viviparidae Bellamya, and the worm, Limnodrilus hoffmeisteri, and assessed worm bioaccumulation during a 28 days experiment. The results showed that TCS has developed a greater affinity with particles in the fine mode, while AA responded mainly to particles in the coarse fraction. DCFH results appear to be driven by a competition between several factors, some increasing the response and some suppressing it. Fang, T. et al.: Oxidative Potential of Ambient Water-Soluble PM2.5 in the Southeastern United States: Contrasts in Sources and Health Associations between Ascorbic Acid (AA) and Dithiobis(2-thiocetamidothiobenzensulfonate (TTATTP) Assays. Atmos. Chem. Phys. 2016, 16, 3865-79. 10.5194/acp-16-3865-2016 Huang, W. et al: Optimization of the Measurement of Particle-Bound Reactive Oxygen Species with 2,7′-dichlorofluorescin (DCFH), Water Air Soil Pollut. 2016, 227, 164.

Emerging pollutants (EPs) are defined as substances that have been detected, which is not included in the routine monitoring programmes at the EU level, and whose fate, behaviour and ecotoxicity effects are not well understood. Pharmaceuticals used in the treatment of HIV, known as anti-retrovirals, are becoming prevalent and there is a need to quantify, detect and minimise any adverse affects to aquatic and human health. Nevirapine (NVP) is commonly used in the anti-retroviral treatment of HIV infection. It is known as a non-nucleoside reverse transcriptase inhibitor of the dipyridamidine class, commonly used to minimize viral resistance. This study reports the isolation and chromatographic characterisation of NVP in wastewater samples, with concentrations ranging between 250 to 500 ng/L. Further evaluation of the impact of NVP on the aquatic ecosystem was also considered and reported in this study. Keywords: Anti-retrovirals; Emerging pollutants; Chromatography; Wastewater

TCP and DBT have been shown to induce DNA damage in vivo and in vitro. TCP should be regarded as genotoxic to the aquatic environment. However, only a few studies have assessed the impact of TCP and DBT on aquatic organisms (Rabert et al., 2008; Poirier et al., 2008). The aim of the present investigation was to evaluate the effect of TCP and DBT on C. elegans and zebrafish. Therefore, a new test system was developed. For zebrafish, TCP and DBT caused a dose-dependent increase in the number of malformed embryos and larvae, and a decrease in hatching and survival rates. For C. elegans, TCP and DBT caused a dose-dependent increase in the number of dead eggs and larvae, and a decrease in the number of hatchlings. The results of this study indicate that TCP and DBT are genotoxic to both C. elegans and zebrafish. These findings support the view that TCP and DBT are hazardous to the environment and should be further investigated.
Environmental Safety
Protection goals for the ecological risk assessment of chemicals are increasingly being framed in terms of ecosystem service delivery [1]. However, the type of data collected to assess risk is generally at the level of individual organisms or simplified multi-species systems. Currently, extrapolation from what is measured to what we want to protect uses overly simplistic approaches, such as risk quotients or toxicity-exposure ratios. Ecological models provide a more mechanistic way of considering these disparate levels and allow for integration of other relevant information as well as feedbacks across levels of organization [2]. Here we present output from the National Institute of Mathematical and Biological Synthesis (NIMBioS) working group (www.nimbios.org/workinggroups/WG_o2e). The two case studies provide a demonstration of a recently developed framework that allows quantification of the mechanistic impacts of the effects of chemicals and other stressors from impacts on individual organisms to the delivery of ecosystem services [3]. The first case study applies an individual-based model (IBM) [4] to quantify impacts of potential endocrine disrupting chemicals on services provided by trout populations in a mountain stream in Colorado, USA. The second case study uses an aquatic ecosystem model [5] to evaluate impacts of an insecticide on multiple ecosystem services delivered by a lake ecosystem, modified to represent a reservoir in Iowa, USA. The first case study is an example where managing for provision of the service GCT population provides will differ depending on the level of EE2 in the system. If EE2 concentrations are low, then management would need to focus on controlling BT populations. For high concentrations of EE2, management first needs to focus on reducing EE2, followed by control of BT. The second case study is an example where game fish species responded differentially to exposure to the insecticide, as a result of interspecific interactions, and the economic valuation of this service needs to take into account with angler preferences. The service of water clarity for recreational activities was valued using threshold-based estimations of days fit for recreation. We provided concrete examples of how ecological modeling can be used to quantify impacts on ecosystem services from data gathered in standard testing. We discuss challenges and ways forward.

TU378
Sulphur: conflicting protection goals
G. Brouwer, Delphy / team fruitateel; F.M. Bakker, Eurofins-Miton
Sulphur is a key fungicide in biological fruit production. Following a recent risk assessment, the use of sulphur in The Netherlands has been rigorously limited. Current registrations allow for two applications, which is incompatible with disease control in biological top fruit production. The regulatory decision was technically correct and based on considerations for non-target arthropods, as risk for the egg parasitoid Trichogramma could not be excluded. Under current European regulations Trichogramma is one of the sensitive indicator species selected for higher tier testing. As this is a natural enemy of several Lepidopteran pest species, the indicator is clearly linked to the specific protection goal of preserving natural pest control potential. However, in the absence of alternatives, at a broader level this specific objective frustrates the current system of biological production as a whole. The specific protection goal must clearly be balanced against the broader objective of preserving biological production. To understand the importance of egg parasitoids such as Trichogramma in Dutch orchards, the Dutch Fruit Growers Organisation have investigated the control potential of egg parasitoids in 8 orchards (4 biological, 2 conventional and 2 untreated), using parasitization rate as a functional endpoint. The investigations show that parasitization rates are extremely low (< 1% of bait cards and < 0.005% of the host eggs showed parasitization), suggesting that a minor role and other egg parasitoids in these systems in The Netherlands, at least at the time of the study (late summer 2017). Conventional orchards showed no parasitization and regular (i.e. having sulphur treatments) and untreated orchards did not show differences. These results show that specific protection goals may have country specific weight and need to be considered and balanced against potential negative impacts of eventual protective measures, such as in this case jeopardizing biological top fruit production.

The Need for Resilience in Environmental Impact Assessment (P)

TU379
Recovery in environmental risk assessments at the European Food Safety Authority (EFSA)
T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; F. Bigler, Retired; G. Frampton, University of Southampton; C. Hogstrand, Kings College London / Division of Diabetes and Nutritional Epidemiology; R. Luntik, Retired; F. Martin-Laurent, INRA Dijon; C.J. Topping, Aarhus University / Department of Bioscience; W. Van der Werf, Wageningen University; A. Rortais, European Food Safety Authority
The European Food Safety Authority (EFSA) performs environmental risk assessments for single potential stressors such as plant protection products, genetically modified organisms and feed additives and for invasive alien species that are harmful for plant health. In 2015-2016 a Working Group of the Scientific Committee of EFSA (the authors of this abstract) explored how ecological recovery is covered under current single-stressor Environmental Risk Assessment (ERA)
schemes at EFSA and how recovery could be assessed considering the complexity of the environment. An important aim of these activities was to promote a dialogue between different panels of EFSA and risk assessors and risk managers responsible for the food and feed chains. Another important aim was to provide risk assessors with a conceptual framework to address ecological recovery in ERAs for any assessed products, and invasive alien species that are harmful for plant health. This framework proposes an integrative approach based on well-defined specific parameters and goals, the use of experimental data, and the use of metrics of environmental quality, modelling and monitoring, and the selection of focal taxa, communities, processes and landscapes to develop environmental scenarios to allow the assessment of recovery of organisms and ecological processes at relevant spatial and temporal scales. Due to the complexity of ecological systems and the need to evaluate effects and impacts on biodiversity in space and time caused by natural and anthropogenic events, a systems approach is required. The systems approach allows the integration of the various species, environmental factors, scales, and stressor-related responses necessary to address the context dependency in ecological recovery. The presentation will highlight the most important conclusions, challenges and recommendations to appropriately address ecological recovery in ERA for potential stressors that fall under the remit of EFSA. EFSA Scientific Committee. 2016. Recovery in environmental risk assessments at EFSA. EFSA Journal 2:016; 14(2):4313, 85 pp

TU380 Habitat Equivalency Analysis for a Restoration Resilience Model of the Rio Dôce Basin
P.N. Booth, Ramboll Environ / Ecological Sciences; E. Singer, F. Gomes, R. Arantes, Ramboll Environ / Sao Paulo; R. Wenning, Ramboll Environ
A Resilience Model was prepared to support environmental, economic, and social restoration of the Rio Dôce Basin after the Fundação Dam failure in Mariana, Minas Gerais State, Brazil. A Habitat Equivalency Analysis (HEA) was applied to quantify lost ecosystem services resulting from the disaster and was intended as a management tool to evaluate the potential habitat restoration needs. HEA is being refined through a process of stakeholder engagement to determine the valued environmental components (VECs); and thus the valued ecosystem services that should drive the resilience restoration goals for each reach of the Rio Dôce River. HEA is a well-accepted spatially and temporally explicit method for integrating multiple complex and difficult to measure environmental variables into a few metrics to determine overall losses and gains in ecosystem services resulting from impacts or restoration actions. The HEA method is adaptable to any ecosystem and its flexibility allows for variability in the valuation of ecosystem services between communities and cultures. This paper focuses on the development and application of HEA within the context of the Resilience Model, and how selection of VECs as indicators to guiding decisions at multiple scales, and location of restoration is aimed at developing an overall ecosystem restoration program that is at once cost-effective and results in a more resilient Rio Dôce Basin.

TU381 Using recovery and information in environmental risk-cost benefit analysis for determining appropriate risk management actions at major industrial facilities
A.E. Bartram, Ramboll Environ / Product Safety, Ecology and Sediment Management; S. Deacon, Ramboll Environ & Health Limited
Operators of chemical manufacturing plants and fuel storage depots are required to undertake site safety assessments, with specific emphasis on the control of major accidental releases of chemical substances. SEVESO II/SEVESO III requires that facilities are in close proximity to water bodies, the coast, and or protected conservation areas. Site safety reporting requires an initial risk assessment be undertaken. The assessment draws upon both the potential severity of harm and environmental recovery in order to determine the risk tolerability under accidental release scenarios. Industry guidance exists on the evaluation of harm, but corresponding guidance on the evaluation of impacted ecosystems is required. For effort to guide rational and cost-effective strategies to manage their regulatory obligations and financial liabilities. A customised probabilistic risk model was developed to facilitate the management of environmental and reputational risks at a portfolio of over 500 industrial sites in Spain. The sites are equipped with industrial equipment that contains large amount of oil. The equipment differs significantly in age, design, and structure, and is equipped with non-standardised spill containment systems. The sites are distributed throughout the Spanish mainland and in the Balearic and Canary Islands, and their environmental and social settings show a large variability. Site investigations were known to have been performed at only 5% of the sites. Initially an Environmental Risk Assessment Model was developed using technical, regulatory, social and environmental data. The compiled and consolidated data were entered into a calculation model developed in Microsoft Office Excel. Monte Carlo simulation was used to manage the potential range of scenarios that could be associated with particular assumptions in the model. Oracle B’s Crystal Ball was used to assign probability distributions to such uncertain model inputs. Probabilistic inputs were considered as risk scenario triggers for specific events at specific sites, such as: the likelihood of historic contamination being detected; a new contamination event being generated either on-site or off-site; a subsidisation strategy being triggered; soil remediation being required; active or passive groundwater remediation being required; and implementation of a groundwater monitoring programme being required. Probabilistic inputs were also applied to the various cost scenarios that might be triggered. The model generated an environmental risk ranking expressed in purely financial terms. Ten high risk and 23 moderately high-risk sites were identified and an environmental action plan focusing on these highest priority sites was prepared. This allowed the portfolio owner to direct financial and human resources required for site investigation, remediation and preventative maintenance to those sites which could give rise to the highest financial and reputational liabilities.

TU384 Quality stakeholder involvement for resilience in environmental risk
P. Wouters, M. Ferreira, I. Harper, Ramboll Environ / Environment and Health; P. Salinas, Red ElÁctrica de Espaa
Companies owning large portfolios of properties are often faced with a high degree of uncertainty in relation to the subsurface conditions of their sites. This makes it difficult, if not almost impossible, to develop and implement rational and cost-effective strategies to manage their regulatory obligations and financial liabilities. A customised probabilistic risk model was developed to facilitate the management of environmental and reputational risks at a portfolio of over 500 industrial sites in Spain. The sites are equipped with industrial equipment that contains large amount of oil. The equipment differs significantly in age, design, and structure, and is equipped with non-standardised spill containment systems. The sites are distributed throughout the Spanish mainland and in the Balearic and Canary Islands, and their environmental and social settings show a large variability. Site investigations were known to have been performed at only 5% of the sites. Initially an Environmental Risk Assessment Model was developed using technical, regulatory, social and environmental data. The compiled and consolidated data were entered into a calculation model developed in Microsoft Office Excel. Monte Carlo simulation was used to manage the potential range of scenarios that could be associated with particular assumptions in the model. Oracle B’s Crystal Ball was used to assign probability distributions to such uncertain model inputs. Probabilistic inputs were considered as risk scenario triggers for specific events at specific sites, such as: the likelihood of historic contamination being detected; a new contamination event being generated either on-site or off-site; a subsidisation strategy being triggered; soil remediation being required; active or passive groundwater remediation being required; and implementation of a groundwater monitoring programme being required. Probabilistic inputs were also applied to the various cost scenarios that might be triggered. The model generated an environmental risk ranking expressed in purely financial terms. Ten high risk and 23 moderately high-risk sites were identified and an environmental action plan focusing on these highest priority sites was prepared. This allowed the portfolio owner to direct financial and human resources required for site investigation, remediation and preventative maintenance to those sites which could give rise to the highest financial and reputational liabilities.

TU382 Addressing Resilience in Ecosystem Services Assessment
K. Molinari, Ramboll EAH / Ecological Services; R. Wenning, Ramboll Environ / Ecology & Sediment Management; E. Bizzotto, H.R. Diogo, Ramboll / Ecological Services
An ecosystem services approach to landscape and nature restoration planning and damage assessment should fully account for all aspects of the environment and the human well-being derived from protection, enhancement and repair to natural resources caused by natural or human-caused events. With respect to damage assessment, conceiving of a resource as a part of an ecosystem that supplies valuable goods and services to people provides a basis for measuring changes and for valuation of those goods and services. With respect to landscape and nature restoration planning, an ecosystem services approach can lead to innovative ideas for ecological infrastructure in cities and promote ecological rehabilitation that may be ecologically and socially desirable and also economically advantageous. Resilience, however, is a key consideration that, to date, has been inadequately considered in ecosystem services assessment work. Considerations of resilience are especially important in ecosystems, because increasing resilience can reduce the risk that highly valued goods and services will cross critical thresholds and irreversibly degrade or change. Resilience also plays an important role in maintaining ecosystem services. If natural conditions are altered, resilient ecosystems will stabilize and recover quickly to a prior or new baseline condition such that the flow of goods and services can be assured. This paper discusses three technical challenges that must be overcome for incorporating resilience in ecosystem services planning work. First, baseline conditions must be established for the goods and services produced by the ecosystem prior to altering the environment or repair, if required; these conditions should be the land use or human-caused disasters. Associated with this challenge is the added complication of shifting baselines in the context of climate change, which generates considerable uncertainties for projecting future recovery of services. The second challenge relates to the establishing the relative values of different ecosystem services, and corrected changes to projected value and society in the future. The third challenge is the limited ability of current ecosystem models to provide defensible projections of the complex and intertwined social-ecological relationships defining a future sustainable flow of goods and services.

TU383 Use of cost modelling techniques to manage environmental subsurface risks, liabilities and uncertainties in Spain
P. Wouters, M. Ferreira, I. Harper, Ramboll Environ / Environment and Health; P. Salinas, Red ElÁctrica de Espaa
Companies owning large portfolios of properties are often faced with a high degree of uncertainty in relation to the subsurface conditions of their sites. This makes it difficult, if not almost impossible, to develop and implement rational and cost-effective strategies to manage their regulatory obligations and financial liabilities. A customised probabilistic risk model was developed to facilitate the management of environmental and reputational risks at a portfolio of over 500 industrial sites in Spain. The sites are equipped with industrial equipment that contains large amount of oil. The equipment differs significantly in age, design, and structure, and is equipped with non-standardised spill containment systems. The sites are distributed throughout the Spanish mainland and in the Balearic and Canary Islands, and their environmental and social settings show a large variability. Site investigations were known to have been performed at only 5% of the sites. Initially an Environmental Risk Assessment Model was developed using technical, regulatory, social and environmental data. The compiled and consolidated data were entered into a calculation model developed in Microsoft Office Excel. Monte Carlo simulation was used to manage the potential range of scenarios that could be associated with particular assumptions in the model. Oracle B’s Crystal Ball was used to assign probability distributions to such uncertain model inputs. Probabilistic inputs were considered as risk scenario triggers for specific events at specific sites, such as: the likelihood of historic contamination being detected; a new contamination event being generated either on-site or off-site; a subsidisation strategy being triggered; soil remediation being required; active or passive groundwater remediation being required; and implementation of a groundwater monitoring programme being required. Probabilistic inputs were also applied to the various cost scenarios that might be triggered. The model generated an environmental risk ranking expressed in purely financial terms. Ten high risk and 23 moderately high-risk sites were identified and an environmental action plan focusing on these highest priority sites was prepared. This allowed the portfolio owner to direct financial and human resources required for site investigation, remediation and preventative maintenance to those sites which could give rise to the highest financial and reputational liabilities.
assessments. Y. Tomkiv, Norwegian University of Life Sciences (NBIM) / Faculty of Environmental Sciences and Natural Resource Management; B. Wynne, Norwegian University of Life Sciences / Centre for Environmental Radioactivity CERAD CoE; D. Oughton, Norwegian Public Roads Administration / Norwegian University of Life Sciences / Centre for Environmental Radioactivity (CERAD CoE).

There is a global call for sustainability and systemic approaches in environmental risk assessment that consider economic and societal aspects of risk, in addition to the environmental aspect. Early and effective stakeholder involvement plays fundamental role in these considerations. Stakeholder involvement is actively utilized in both policy and research, moreover, it is widely recognized that stakeholders will increasingly influence future consideration of environmental risk and assessment, including decision-making. However, it is important to ensure the quality of the stakeholder involvement activities in order to support democratically legitimate and robust processes. However, the existing systems of criteria tend to be focused on a rather narrow evaluation of the method applied. We argue that there is need for evaluation that goes beyond a simple assessment of the methodology and addresses the wider context that the stakeholder involvement activity is held in. This paper uses two stakeholder engagement events: one from the field of emergency preparedness and one from nanoremediation, to explore the applicability of existing evaluation criteria for a quality assessment of stakeholder or broader public involvement. We use criteria developed by Rowe and Frewer (2000), namely, representativeness, independence, influence, transparency and early involvement. A particular focus was put on young children, leading to demographic changes in societies. Other social and cultural impacts arise from lack of access to beaches, places of heritage and festivals. The economic consequences from food bans go beyond that of sales, market value decreased in all products from the area due to loss in consumer trust (20% decrease compared to the rest of Japan). Strategies for radiation risk management are often at odds with the actual needs of the affected populations, and if not carried out properly can cause more harm than good. Recognising this, the EU SHAMISEN project has published a set of recommendations to improve radiation risk management after a nuclear accident. Experience suggested that existing recommendations had a technical focus, with less attention paid to social, ethical, psychological issues and that the information tended to be directed towards the project stakeholders.

TU385
Assessment and Management of Radiation Risks following a Nuclear Accident: The Shamasien Project Recommendations
D. Oughton, Norwegian Public Roads Administration / Norwegian University of Life Sciences / Centre for Environmental Radioactivity (CERAD CoE); E. Cardis, ISIGlobal; T. Schneider, CEHN; Y. Tomkiv, Norwegian University of Life Sciences / Centre for Environmental Radioactivity CERAD CoE

The Fukushima Daiichi accident in 2011 represents a poignant reminder of the enormous. The loss of livelihood from bans on fishing and farming have been low, particularly for families with young children, leading to demographic changes in societies. Other social and cultural impacts arise from lack of access to beaches, places of heritage and festivals. The economic consequences from food bans go beyond that of sales, market value decreased in all products from the area due to loss in consumer trust (20% decrease compared to the rest of Japan). Strategies for radiation risk management are often at odds with the actual needs of the affected populations, and if not carried out properly can cause more harm than good. Recognising this, the EU SHAMISEN project has published a set of recommendations to improve radiation risk management after a nuclear accident. Experience suggested that existing recommendations had a technical focus, with less attention paid to social, ethical, psychological issues and that the information tended to be directed towards the project stakeholders.

TU386
SETAC Ecosystem Services Interest Group
S.E. Apitz, SEA Environmental Decisions Ltd

Air Pollution, Biomonitoring and Human Health (P)

TU387
Assessment of Indoor Radon Concentration and Trace Metals Composition in University Building Microenvironments
M. Mohamed Ali, Universiti Kebangsaan Malaysia; M. Mohd Hanafiah, Universiti Kebangsaan Malaysia / Environmental Science; M. Khan, Universiti Kebangsaan Malaysia / Centre for Tropical Climate Change System

This study measures the indoor particulate matter (PM$_{10}$) concentration and the equilibrium equivalent radon (EEC$_{Rn}$) concentration in two university buildings with different ventilation systems. A low-volume sampler using Teflon filter paper was used to collect the PM$_{10}$ samples and indipectively coupled plasma mass spectrometry was used to determine the concentration of heavy metals. The concentration of indoor radon was measured using a radon detector model DOSeman PRO. The potential human health damage due to the inhalation of carcinogenic and non-carcinogenic trace elements was also determined based on the US EPA standard. The equilibrium factor and the annual effective dose on the lung cancer risks of each occupant were calculated and a correlation of the radon concentration was made with the annual inhalation dose of the occupants at the building stations. The results showed PM$_{10}$ concentrations recorded in Building 1 and Building 2 ranged between 19.1 to 237 µg m$^{-3}$ and 23.4 to 159 µg m$^{-3}$, respectively.

In Buildings 1 and 2, the principal component analysis and multiple linear regression showed that the main source of pollutants in PM$_{10}$ were from the crustal source (20%) and combustion (21%), respectively. The effective lifetime carcinogenic risks (ELCR) in Buildings 1 and 2 were 1.90E-3 and 1.65E-4, respectively. The hazard quotient (HQ) represents the non-carcinogenic risk, with 7.73 and 6.46 in Building 1 and Building 2, respectively. The average equilibrium equivalent radon measured in Building 1 and Building 2 was 2.33 ± 0.99 and 3.17 ± 1.74 Bqm$^{-3}$, respectively. The average annual inhalation doses recorded at Buildings 1 and 2 were 0.014 ± 0.005 mSv y$^{-1}$ and 0.020 ± 0.013 mSv y$^{-1}$, respectively. For trace metals, the ECLR and HQ values were found to exceed the permissible limits suggested by US EPA, whereas the values of equilibrium equivalent radon concentration were still below the standard recommended by ICRP.

TU388
Paradigm for PM2.5 Chemical and Biological Characterization: Paired Home and Personal PM2.5 Samples in Kheri, India
C. Roger, A. Perez, Oregon State University / Department of Environmental and Molecular Toxicology; P. Hystad, Oregon State University / College of Public Health and Human Sciences; S. Simonich, Oregon State University / Depts of Chemistry and Environmental Molecular Toxicology; R.L. Tanguay, Oregon State University / Sinnhuber Aquatic Research Laboratory and the Environmental Molecular Toxicology

The global public health impact from household fine particulate matter (PM$_{2.5}$) is extremely large however, there is a limited understanding of health effects associated with specific PM$_{2.5}$ chemical constituents as well as the underlying mechanisms of these adverse health effects. These research gaps can be addressed through use of a high-throughput screening platform to quickly gain biological response data. A subset of homes in Kheri, India that participated in the Prospective Urban and Rural Epidemiological (PURE)-AIR pilot study were selected to identify differences in chemical and biological measurements of household PM$_{2.5}$. In 6 households, personal air monitors collecting PM$_{2.5}$ were worn by female participants and paired with stationary monitors, resulting in personal (n=6) and home (n=6) PM$_{2.5}$ filters for each household. PM$_{2.5}$ was removed from filters via sonication in methanol. Aliquots of individual filter samples were removed for oxidative potential assessment. Remaining PM$_{2.5}$ samples of the same collection method were then pooled (n=6/group) and the soluble fraction of PM$_{2.5}$ from DMSO extraction was prepared for developmental toxicity testing performed in zebrafish (n=32/treatment) starting at 6 hours post fertilization (hpf). Aliquots of the pooled samples were used for chemical analysis (polycyclic aromatic hydrocarbons (PAHs, n=20), elements (n=20)) and oxidative potential assessment with methods identified those used for filter controls. Significant differences were observed in oxidative potential between personal and home PM$_{2.5}$ for both individual and pooled samples. Significant mortality in zebrafish was observed starting at 24 hpf in personal PM$_{2.5}$ samples and by 120 hpf in home PM$_{2.5}$ compared to blank filter controls. Chemical analysis is underway to allow for correlations to be investigated between these biological responses and chemical constituents. This research is the first study to use paired home and personal PM$_{2.5}$ samples with chemical, oxidative potential, and developmental toxicity data, identifying the differences in these measurements between household and personal PM$_{2.5}$. Importantly, it outlines procedures for large-scale analysis of the PURE-AIR study which includes planned PM$_{2.5}$ measurements in 4,000 homes and will ultimately allow for correlation of human health effects with chemical and biological data to identify improved health metrics for PM$_{2.5}$ exposures.

TU389
Toxicity of airborne particulate matter as a factor to choose the most convenient school
F. Sánchez, F. Schuhmacher, Roivia i Virgili / Chemical Engineering; N. Serra, Universitat Rovira i Virgili / Laboratory of Toxicology and Environmental Health; V. Linares, Universitat Rovira i Virgili / Laboratory of Toxicology and Environmental Health; M. Bellés, Universitat Rovira i Virgili / Laboratory of Toxicology and Environmental Health; M. Schuhmacher, Roivia i Virgili University / Departament d Enginyeria Química

One of the critical decisions parents have to face is choosing a good school for their kids. Proximity, high ratio of teachers to students, and access to convenient educative infrastructures are the driving factors determining school’s choice. However it is used to assume that environmental air inside schools is safe enough.
Among the different air pollutants found in schools, PM$_{2.5}$ (airborne particulate matter smaller than 2.5 µm; also referred as "fine PM") is considered as the most injurious one. Since this pollutant is potentially very harmful, toxicity of PM$_{2.5}$ on lung cells has been widely studied. However, most of the publications on this topic are focused on studying PM$_{2.5}$ effects on human alveolar cells for short periods of time after applying doses far higher than environmental levels. To surpass this gap, we have performed a present study. In it, we conducted two fractions of fine PM (PM$_{2.5}$, PM$_{1}$, PM$_{0.5}$) in indoor classroom of schools located under the influence of three different environments: urban, petrochemical, and chemical. Subsequently, we exposed human alveolar epithelial cells (A549) to IC$_5$ doses obtained from a previous study. Then, apoptosis and release of 17 cytokines from the cells was studied after five different exposure times: 0, 6, 24, 48, and 72 hours. Preliminary results showed no differences in cytokines release levels among the two PM sizes or three sampling sites. However, differences arose when comparing the levels of seven cytokines (MCP-1, TNF-α, INF-γ, G-CSF, IL-6, IL-7, and IL-8) versus exposure times. These differences became significant after 24-48 h from exposure, and increased till reaching the maximum value after 72 hours. Results from this study will be useful not only to better understand the way of action of PM$_{2.5}$, but also to school managers and parents.

TU390

Acute Impacts of Extreme Hot Temperature Exposure on Emergency Room Y. Lan, C. Chang, C. Chung, China Medical University Abstract The purpose of this study was to assess the effects of extremely high air temperatures on hospital emergency room visits (ER) related to alcohol addiction and other mental illnesses in Taiwan. A time series study was conducted using health and climatic data from 2000 to 2010 in Taiwan. A national health insurance database, temperature database, and air quality surveillance database were used for this study. Relative risks (RRs) for increases in emergency room (ER) visits were estimated for alcohol addiction and other mental illnesses after exposure to extreme heat temperatures (99th percentile) of the daily mean temperature as reference. Poisson regression models using a distributed lag non-linear model (DLNM) were used. We adjusted for the effects of humidity and outdoor air pollutants. We found an association between alcohol addiction and other mental illnesses and mean daily temperature at 23.6° on ER visits. The association was strongest within 0-7 days after exposure to high temperatures. Increases (RR 1.02, 95% CI 1.01–1.04) in a major depressive disorder (MDD) ER visits was observed over a cumulative period of 7 days after exposure to high ambient temperature (99th percentile vs. 50th percentile). The opposite association was reported for alcohol addiction (RR 0.99 , 95% CI 0.98–0.99). No significant associations with anxiety, dementia, and delirium were estimated. Our findings suggest that extreme temperatures pose a risk to the health and wellbeing for individuals with alcohol addiction and other mental illnesses.

TU391

Characteristics of Polybrominated Diphenyl Ethers Released from Primitive E-Waste Treatment F. Li, Jinan University, J. Zhou, C. Wu, L. Bao, L. Shi, E.Y. Zeng, Jinan University / School of Environment Primitive processing of e-waste potentially releases abundant organic contaminants to the environment, but the magnitudes and mechanisms remain to be adequately addressed. The present study conducted thermal treatment and open burning of typical e-wastes, i.e., plastics and printed circuit boards. Emission factors of the studied e-wastes were also calculated. Polybrominated diphenyl ethers (PBDEs) and the up to 81% of the original BDE-47 to 99% of the original BDE-209 in PM$_{2.5}$ and BDE-47 to 60% of the original BDE-209 in PM$_{10}$ were reported. Our results show that extreme temperatures pose a risk to the health and wellbeing for individuals with alcohol addiction and other mental illnesses.

TU392

How risky is the schoolyard? An approach from chemical composition of particulate matter F. Kasicki, School of Environment, Universitat Rovira i Virgili / Chemical Engineering; J. Rovira, Universitat Rovira i Virgili; J. Sierra, Faculty of Pharmacy University of Barcelona / Faculty of Pharmacy, Soil Science Unit; M. Schuhmacher, Rovira i Virgili University / Departament d Enginyeria Quimica According to last estimations, there are globally around 6.5 million deaths as a consequence of exposure to air pollutants. Among them, Particulate Matter (PM) is considered as the most harmful one. This material consists on solid particles and liquid droplets suspended in the atmosphere having a diameter smaller than 10 µm. Since they can come from a wide array of different sources (i.e. traffic, industries, indoor dust) their physicochemical characteristics are very heterogeneous, and knowing them becomes important in order to assess its damaging potential. To improve the knowledge regarding physicochemical characteristics of PM that children are exposed in schools we conducted a study focused on finding out chemical characterization of PM$_{10}$, PM$_{2.5}$, and PM$_{1}$ (i.e. particles smaller than 10, 2.5 and 1 µm respectively) in an industrial area in Tarragona (Spain). Three these fractions of PM were collected in the schoolyard (high volume samplers Tisch 470-DV, Tisch) and inside the classroom (low volume Sioutas cascade impactor, SKC) of 12 schools during two seasons (winter and summer). Subsequently, chemical characterization of the particles (through the analysis of metals, soluble ions and carbonaceous materials) was performed. Preliminary results show that both indoor and outdoor levels of PM are higher in winter than in summer. Indoor/outdoor ratios of particles are varying, showing some schools higher PM levels indoors, while the opposite phenomenon is observed in other. Consequently, concentrations of the different chemical constituents of particles are variable, although indoor particles trend to have higher shares of carbonaceous materials. Our results will be useful not only to schools managers and parents, but also to policy makers in order to assess risk coming from the inhalation of these materials.

TU393

Good news to lazybones kids: increasing sleeping time decreases exposure to airborne particulate matter F. Sánchez Soberón, Universitat Rovira i Virgili / Chemical Engineering; F. Noardo, Universitat Rovira i Virgili / Department of Chemical Engineering; M. Mari, Universitat Rovira i Virgili / Faculty of Pharmacy, Soil Science Unit; M. Schuhmacher, Rovira i Virgili University / Departament d Enginyeria Quimica; M. Schuhmacher, Rovira i Virgili University / Departament d Enginyeria Quimica Particulate matter (PM) is a complex mixture of extremely small particles (< 10µm) and liquid droplets suspended in the atmosphere. They are originated from a wide range of sources (such as traffic, industry, energy production or domestic combustion). Nowadays, the inhalation of this pollutant is a concern due to its potential to cause irritation and inflammation of respiratory airways, asthma attacks, and lung cancer. These effects are especially pernicious in kids, since their inhalation rates are higher, and their immune system is still not fully developed. However, most studies dealing with human exposure to PM are focused on adults. Therefore, the objective of the present study was to evaluate the children’s exposure to different sizes of PM. To do so, three fractions of PM (smaller than 10, 2.5, and 1 µm) were collected in the playground and inside a classroom of 12 schools within the Tarragona county (Spain), an area characterized by having one of the most prominent industrial clusters in southern Europe. To elucidate time-activity patterns of kids, and to know the characteristics of their dwellings, questionnaires were delivered to parents of kids attending these schools. Using an infiltration model (IAQX, US EPA) it was possible to calculate concentrations of PM inside houses. A subsequent run of a dosimetry model (MPPD2.11, ARA) made possible to know the deposition pattern of the different PM sizes within the distinct parts of the respiratory tract. Indoor/outdoor ratios of PM levels were variable among schools. Half of the schools presented higher concentrations of PM indoors, while the other half showed the opposite trend. Simulations indicated the great influence of PM$_{2.5}$ indoors, due to its easier capacity of infiltration from outdoors. Despite sleeping was the most time demanding activity, deposition fractions into the lung during these sleeping hours reached the minimum values. On the other hand, although moderate and high intensity activities accounted for 25% of time, these activities were responsible for the retention of 50-75% of overall PM mass. Most of this mass remained in the respiratory airways, mainly due to sedimentation processes. Tracheobronchial region registered the lowest values of deposited particles, while PM retained in the lung was mostly PM$_{2.5}$ and PM$_{1}$. Results from this study will help to take actions regarding indoor air quality and perform more accurate risk assessment studies.

TU394

Occupational Cement Dust Exposure: effect on blood level of some antioxidant enzymes and vitamins in Overri, Nigeria. C. Ikaraoha, J.A. Egeonu, Imo State University Owerrri, Imo State, Nigeria / Chemical Pathology Unit Dept of Medical Laboratory Science; C. Unadike, Imo State University Owerrri, Imo State, Nigeria / Medical Laboratory Science; M. Mbadiwe, University of Nigeria Teaching Hospital, Enugu, Nigeria / Medicine; J. Dike-Ndum, Imo State University Owerrri / Department of Medical Laboratory Science ABSTRACT Despite that Cement dust with particulate matters are hazardous to humans, yet Occupational cement dust exposure continues among Cement workers. The study was to determine the blood levels of some antioxidants enzymes and vitamins in councillors cement workers in Nigeria. Among them, Particulate Matter (PM) is considered as the most harmful one. This material consists on solid particles and liquid droplets suspended in the atmosphere having a diameter smaller than 10 µm. Since they can come from a wide array of different sources (i.e. traffic, industries, indoor dust) their physicochemical characteristics are very heterogeneous, and knowing them becomes important in order to assess its damaging potential. To improve the knowledge regarding physicochemical characteristics of PM that children are exposed in schools we conducted a study focused on finding out chemical characterization of PM$_{10}$, PM$_{2.5}$, and PM$_{1}$ (i.e. particles smaller than 10, 2.5 and 1 µm respectively) in an industrial area in Tarragona (Spain). Three these fractions of PM were collected in the schoolyard (high volume samplers Tisch 470-DV, Tisch) and inside the classroom (low volume Sioutas cascade impactor, SKC) of 12 schools during two seasons (winter and summer). Subsequently, chemical characterization of the particles (through the analysis of metals, soluble ions and carbonaceous materials) was performed. Preliminary results show that both indoor and outdoor levels of PM are higher in winter than in summer. Indoor/outdoor ratios of particles are varying, showing some schools higher PM levels indoors, while the opposite phenomenon is observed in other. Consequently, concentrations of the different chemical constituents of particles are variable, although indoor particles trend to have higher shares of carbonaceous materials. Our results will be useful not only to schools managers and parents, but also to policy makers in order to assess risk coming from the inhalation of these materials.
P=0.0001, P=0.001 and P=0.0011) respectively. There were significant decreases in blood levels of vitamin C, vitamin E, glutathione peroxidase and catalase (P<0.002, P=0.0004, P=0.0001, P=0.0004) respectively in Cement Workers/Dealers compared to Controls. But no significant difference in SOD (P=0.627) on comparison of Cement Workers/Dealers with Non-Cement Workers (Controls).

There was significant decrease in blood levels of vitamin C (P=0.0147), SOD (P=0.0001), and catalase (P=0.0016) respectively, but there was a positive significant correlation of catalase with SOD (P=0.0147). This study suggest that Exposure to cement Dust may lead to reduction in blood levels of vitamin C, vitamin E, Catalase, Glutathione Peroxidase, and SOD in Cement workers/Dealers. The observed reduction/decreases in the antioxidants were progressive from control to Cement Dealers and to cement Workers. Key words: Cement dust, antioxidant, enzymes, vitamins.

TU395 Implementing NH3 mitigation strategies in a pig farm: different approaches to evaluate the environmental impact.
C. Baldini, Università degli Studi di Milano / Department of Environmental Science and Policy; C. Baldini, Università degli Studi di Milano / Department of Environmental Science and Policy; P. Fermo, Università degli Studi di Milano / Department of Chemistry; M. Guarino, Università degli Studi di Milano / Department of Environmental Science and Policy

Ammonia is an atmospheric pollutant causing acidification of soil, nutrient-N enrichment of ecosystems, and eutrophication of terrestrial and aquatic ecosystems. When in gaseous form, NH3 has a short atmospheric lifetime and usually deposits near its source. In the atmosphere it reacts with other compounds to form ammonium sulfate and ammonium nitrate aerosols, leading to the formation of secondary inorganic aerosol (PM2.5) that are a potential health hazard. Due to their smaller diameter and increased atmospheric lifetime, these particulates are able to travel long distances before being dry or wet deposited to the ground surface. This allows them to travel from rural areas to urban locations where they mix and build up in the atmosphere leading to smog or transportation to other areas. The particular unfavorable meteorological and orographic conditions of the Po Valley make this one of the most polluted region of Europe. Particulate matter pollution often exceeds the EU standards and WHO air quality guidelines for health protection. Being a main source of ammonia emissions, the agro-zoo-technical compartment plays a key role in the secondary PM formation. Indeed, secondary inorganic aerosol from NH3 accounts for 40% of PM2.5 mass at the urban sites, and its contribution is even bigger in the rural sites. This study aims at evaluating the environmental performance of different NH3 mitigation strategies applied to Italian pig farms. Different mitigation scenarios are compared, considering the application of cement dust, antioxidant, enzymes, vitamins. Different strategies can be applied to determine the effectiveness of mitigation options: the SHERPA model or other approaches like Life Cycle Assessment can indicate the environmental benefits achievable with the different scenarios analyzed. Although techniques may be implemented and managed separately, they produce synergistic effect on the farm’s ecosystem. The SHERPA model is an integrated model for air and water emissions of NH3 from pig farming will lead to a higher amount of nitrogen in the manure and to the amount that may potentially be emitted to air as NH during the downstream process of manure storage and spreading. The reduction of NH3 emission from pig farming management steps can have a positive effect in NH-related impact categories, such as PM formation, terrestrial acidification and eutrophication.

TU396 Development of an In Vitro Method to Evaluate the Inhalation Bioaccessibility of Particle-Bound Hydrophobic Organic Chemicals and its Effects of Particle Size
S. Liao, Jinan University; L. Bao, E.Y. Zeng, Jinan University / School of Environment

Bioaccessibility of particle-bound hydrophobic organic contaminants and its effects of particle size are significant for assessing the potential human health risk via inhalation exposure, but have not been clearly evaluated. To fill this knowledge gap, the present study develops an in vitro method to estimate the inhalation bioaccessibility of particle-bound hydrophobic organic compounds using lung fluids, i.e., artificial lysosomal fluid (ALF) and Gamble’s solution amended by dipalmitoyl-sn-glycero-3-phosphocholine, with Tenax as the absorption sink. Polycyclic aromatic hydrocarbons (PAHs) were selected as the target compounds and the assay parameters such as incubation time and the influence of particulate load membrane were examined. Results show that the bioaccessibilities of individual PAH compounds increased with the increasing incubation time and reached the steady state within 10 days. None of significant difference was found for the individual PAH bioaccessibilities between with and without adding glass microfiber membrane into the incubation system. Furthermore, the PAHs absolute recoveries, calculated by sum of PAHs masses in Tenax, artificial lung fluid, and residual particle dividing the initial masses, were from 92% to 112% in ALF and 75% to 99% in Gamble’s solution, suggesting that this developed in vitro method could be well appropriate to evaluate the inhalation bioaccessibility to particulate hydrophobic organics matter. In addition, the PAHs bioaccessibility were found to increase with particle size, but decrease with the increasing hydrophobicity. It is noteworthy that, via the inhalation method, the inhalable particle-bound PAHs was reduced by more than 90% if the size-dependent PAHs bioaccessibility and deposition efficiency were involved into the assessment.

TU397 Toxicity does not vanish into thin air - molecular mechanisms of air pollutant mixtures
Z. Novakova, Masaryk University; J. Novak, Masaryk University / RECETOX; K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; P. Kuucka, P. Pribylova, R. Prokes, Masaryk University / RECETOX; G. Lammel, Max Planck Institute for Chemistry / Multiphase Chemistry Department

Air pollution remains a major issue worldwide, and particulate matter pollution is particularly problematic in some regions worldwide. It can directly affect human health and can contribute to higher incidence of pulmonary and cardiovascular diseases or cancer. Moreover, it has been shown that compounds occurring in the ambient air pose a hazard to disrupt our endocrine, immune or reproductive system. Since the air pollutants occur in complex mixtures, it is more appropriate to use an effect-based monitoring including a battery of in vitro bioassays which cover various interactions among mixture constituents. Bioassays represent an efficient approach for toxicological profiling and identification of pollutant modes of action. Together with chemicals analyses, they enable to identify main toxicity drivers. Two sites were selected, a heavily polluted urban site (industries, transportation, coal-based domestic heating) and a regional background. Samples were collected in summer and winter. To assess the more specific contribution of the size fractionated environmental particulate phase, coarse particulate phase, and six PM2.5 size-fraction samples were sampled. Moreover, samples were also fractionated according to polarity. Human-based in vitro bioassays were employed to study endocrine-disruptive potentials, AhR-mediated induction of detoxification mechanisms, and cyto- and genotoxicity to the human respiratory tract. The results show that the studied effects were associated mainly with particulate phase. The most significant effects were attributed to the easily inhalable fine and ultrafine particles. This distribution pattern was found for example for AhR-mediated toxicity, estrogenicity, and androgenicity. The studied toxic potentials were elicited mainly by chemicals in the polar fraction containing relatively high levels of oxygenated-polyaromatic hydrocarbons (oxy-PAHs). This study confirms that several molecular mechanisms of toxicity are associated with air pollution and highlights the complexity of pollutant mixtures. For further understanding, the results will be discussed together with the results of the chemical analysis which focused on PAHs and their derivatives, nitro- and oxy-PAHs. This research was supported by project GACR P503 16-11537S.

TU398 Human health assessment of air pollution exposure to tuberculosis risk in regions of Taiwan
H. Lin, National Taiwan University; Y. Lin, National Health Research Institutes / National Institute of Environmental Health Sciences; Y. Yang, C. CHEN, National Taiwan University / Bioenvironmental Systems Engineering; C. Liao, National Taiwan University / Bioenvironmental Systems Engineering

BACKGROUND: Ambient air pollutants from anthropogenic sources play critical roles in the prevalence of tuberculosis (TB). Association between ambient air pollution and TB disease burdens should be clearly elucidated. Several studies found that air pollutants were highly likely to pose adverse effects on antimycobacterial immunity mechanisms, increasing risk of TB development. OBJECTIVE: The main objective of this study was to assess the contribution risks to TB incidences resulted from ambient air pollutant exposure. METHODS: A population-based probabilistic risk assessment framework was incorporated with air pollution concentration database and epidemiologic dose-response data to assess contribution risks of air pollutant-associated TB incidences in Taiwan regions. The contribution concept was quantified by using the population attributable fraction (PAF). The air pollution-PAF relationships were assessed by employing a three-parameter Hill model based on hazard ratio data of TB exposed to air pollutants. The contribution of air pollution exposure to TB was evaluated by applying multiplications of PAF likelihood and TB incidence rates. RESULTS: Both under severe and moderate scenarios, the results revealed that the most likely air pollutants significantly contributing to TB incidences were carbon monoxide (CO) and nitrogen dioxide (NO2) in regions of Taiwan. Additionally, the particulate matter (PM2.5) and nitrogen oxides (NOx) also were likely to contribute to TB incidences in some regions. CONCLUSIONS: We suggested that the contributions of air pollutants mainly from diesel combustions (CO, NOx and NO2) to TB incidences are of great concern. Furthermore, the human health risk assessment framework provides an alternative perspective to interpret the effects of air pollution on TB burdens. Keywords: Human health risk assessment; Air pollution; Tuberculosis; Population attributable fraction; Probabilistic risk assessment
TU399
Towards green braking: comparative evaluation of toxicological profile of particles generated by traditional and innovative braking systems.
S. Maiorana, D. Baderna, Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; S. Gemma, L. Brunelli, F. Teodoli, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; D. Depui, Cidere / Nanomedicine; M. Lodi, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; A. Bonfanti, Brembo S.p.A.; E. Benfenati, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences

The protection and improvement of air quality are key critical points of environmental problems, especially in industrialized and urban areas. Inhalation of contaminated air and airborne particles is definitely the main route of exposure to the most important pollutants, secondary only to the diet. Several respiratory and cardiovascular diseases are associated with air pollution. Air pollution is responsible for 400,000 deaths per year in EU/28. In 2013 outdoor air pollution was classified as carcinogenic to man (Group 1) by the International Agency for Research on Cancer, with a special attention to airborne dusts. In addition, powders can alter aquatic and terrestrial ecosystems when they reach the surface waters and soils as a result of transport and deposition events. Road traffic and transport contributes greatly to emissions of PM2.5 and PM10 and an important contribution to the non-exhaustive emission is due to the wear of brakes. The European Life+ COBRA (LIFE13 ENV/IT/000492) project aims to create a safer alternative to the pads currently on the market, replacing the friction material with a new cementitious hydraulic binder. The project has evaluated the chemical and toxicological potential of particulate matters generated in laboratory conditions using test benches capable of simulating vehicle braking cycles. PM2.5, PM10 and deposited non-airborne particles were collected. Fine and coarse particles were detached from the filters and dispersed in an alcohol solution for in vitro assessment of their toxicological potential with non-tumour cell lines HeLa and BEAS-2B cells as model of the respiratory tract. Effects on cell proliferation and cytotoxicity were assessed daily by the MTS assay and the evaluation of DNA-release from damaged cells. Sublethal responses were also measured including oxidative stress, DNA damage, mitochondrial membrane potential and metabolic alterations. In order to evaluate the ecotoxicological effects on seedlings growth and root damages, cress seeds were exposed to standard soil contaminated with non-airborne particles. The innovative cementitious pads were comparable to traditional pads in terms of braking performance but showed significantly reduced airborne particles production. Results showed different toxicity between particles generated from traditional and innovative braking systems: in our experimental models, particles derived from cementitious pads were less toxic than those from the resin based pads.

TU400
Toxic oxidation transformation products of phenanthrene measured in laboratory generated secondary organic aerosol particles
A. Kramer, B. Zorn, D. Spindler, Tufts University / Environmental and Molecular Toxicology; S. L. Massey, S. Simovich, C. Roper, Oregon State University / Department of Environmental and Molecular Toxicology; A. Zelenyuk, Pacific Northwest National Laboratory; K. Suski, Pacific Northwest Laboratories

Oxidized transformation products (OTP) of polycyclic aromatic hydrocarbons (PAHs) have been shown to be more toxic than their parent PAHs, as well as being more ubiquitously found in soils and sediments than the parent PAHs. Thus, PAHs as secondary organic aerosol (SOA) particles. Recent laboratory studies indicate that SOA particles formed in the presence of gas-phase PAHs contain both parent PAHs and their OTP. In laboratory experiments of α-pinene SOA particles, OTP of phenanthrene, a model three-ringed PAH, were observed in varying ratios. Developmental toxicity testing with zebrafish (Danio rerio) will be performed using embryos (n=32/treatment) that will be dechorionated and placed into 96-well plates containing OTP of phenanthrene in observed ratios at 6 hours post fertilization. Developmental toxicity will be assessed by evaluating morphological changes, embryonic/larval photomotor behavior, and mortality at 24 and 120 hours post fertilization. Evaluation of the oxidative potential of the SOA samples as well as individual compounds and observed ratios of compounds is underway using the diethiothreitol (DTT) consumption assay. The results from both assays will be discussed.

TU401
Chemical analysis and risk assessment for toxic compounds in PM2.5 in Gwangju, Korea
I. Kim, Gwangju Institute of Science and Technology; S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering

Particulate matter (PM), a mixture of solid or liquid matter found in the air, has gained considerable attention as a major air pollutant in recent years. It is recently revealed particulate matter, especially PM2.5 (aerodynamic size < 2.5μm) cause numerous diseases such as respiratory, cardiovascular diseases, and asthma and so on. The prime criteria for preventing the adverse effects of PM2.5 are based on the mass concentration, but recent research has shown that the chemical composition of PM2.5 can be a more important factor for determining PM2.5 toxicity than mass concentration. Many researchers reported the diverse chemicals in PM2.5 such as inorganic sulfates and nitrates, black carbon, metal, organic compounds, and others. In addition, a few studied detected organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) in PM2.5 of China. However, there is no researches on OCPs and PCBs within PM2.5 in Korea. In this study, we developed the rapid analysis method for toxic compounds (PAHs, OCPs, PCBs and PBDEs) using an accelerated solvent extractor (ASE) and the total mass of the sites in Korea was collected from Oct. 2016 to Apr. 2017 (for 21 weeks). We determined the toxic compounds in the collected PM2.5 using the developed method and metal concentration in PM2.5 was also analyzed using microwave extraction. Cr, As and Cd showed high concentration in PM2.5 of all sites and several OCP and PCBs also detected. Lastly, we did the risk assessment on metals, PAHs, OCPs and PCBs in PM2.5 of Korea to determine the risk for people. This research is a valuable report on OCPs and PCBs in PM2.5 of Korea and suggests the practical method for screening trace toxicants in PM2.5.

TU402
Source apportionment study of PM10 and PM2.5 using selective wind direction sampling technique in the area of Civitavecchia (Italy)
F. Ghelardi, Istituto Superiore di Sanità / Environment and Health; G. Settimio, m. Inglessis, Istituto Superiore di Sanità / Department of Environment and Health; g. marsili, osservatorio ambientale; m. soggiu, Istituto Superiore di Sanità / Department of Environment and Health

The concentrations of air pollutants (PM10 and PM2.5) and their attribution to specific sources through the source apportionment methodologies is an important research topic in air quality study; in fact, the possibility to discriminate between different emission sources and between natural and anthropogenic contribution is a key issue for planning efficient air pollution reduction and mitigation strategies. Moreover, the knowledge of the chemical composition of PM for the different size fractions is recognized as increasingly important, in particular with respect to health effects of exposed population. The aim of the study is the characterization of PM10 and PM2.5 main sources located in the Civitavecchia harbour-industrial area (Central Italy), namely a large coal-fired power plant, a natural gas power plant, the harbour area, the vehicular traffic (due to both the local traffic and the highway crossing the area) and small industrial activities located in the town. To this purpose, the approach based on the use of PM samplers coupled with a wind-sensor allowing a selective PM10 and PM2.5 sampling downwind to specific emission sources, has been used. Furthermore, the chemical characterization of the PM collected has been carried out in order to explain specific emission patterns, and to assess the concentration levels of the micro-pollutants emitted by local sources and particularly toxic for health. Two sampling sites have been identified in the area, respectively urban and urban background site, and equipped with a PM10 and PM2.5 wind-select sampling device, designed to collect airflows from two directions, downwind respectively the coal-fired power plant and the port area. Samples of PM10 and PM2.5 were monthly collected for one year, and chemical analyses were performed to determine the concentrations of organic and inorganic species. A descriptive statistical analysis of data was performed, also verifying the occurrence of legislative threshold exceedances. Moreover, in order to highlight the contribution of specific sources, the differences in the measured micro pollutants concentrations between wind directions, PM size fractions and sampling sites have been investigated, also as the seasonal trends of pollutants concentrations. These results allow to highlight that the applied methodology represents a valid support in source apportionment studies. Keywords: source apportionment, wind select-sampling device, PM10, PM2.5

TU403
Forecasting global atmospheric visibility based on air quality and meteorological data
H. Xiao, NUEORS, Chinese Academy of Sciences / NUEORS; J. Zhang, L. Tong, H. Yi, M. He, J. Zheng, IUE, Chinese Academy of Sciences

Simultaneous and continuous measurements of visibility, meteorological parameters, including relative humidity, and the concentrations of six atmospheric pollutants (PM10, PM2.5, SO2, NO2, CO and O3) were obtained for several cities around the globe. The characteristics of visibility and relationships with air pollutants and meteorological factors were investigated using multiple statistical methods. Analysis demonstrated that within a certain relative humidity range, visibility is the exponential function of the PM2.5 concentration. Thus, non-linear models combining multiple linear regressions with exponential regression were subsequently developed to describe the hygroscopic growth and the attenuation of aerosols by the air pollutants. The derived models can quantitatively describe the relationships between visibility, air quality and meteorological parameters around the whole globe.

TU404
Analyzing the Asian supply chain structure of health impacts with PM2.5 including secondary particles
F. Nagashima, Kyushu University; K. Nansai, National Institute for Environmental Studies; S. Chatani, National Institute of Environmental Studies; S. Kagawa, Kyushu University
Countries and regions in Asia have played an important role in producing intermediate products and final commodities today and supplied their products around the world. Productions and consumptions of goods and services in the Asian countries have clearly contributed to the economic growth in the world, whereas those economic activities brought about environmental loads. Particularly, China’s emissions of air pollutants such as fine particulate matter (PM2.5) have caused some severe environmental and public health problems in such countries. Further research on these health impacts associated with the PM2.5 through the Asian supply chains have been estimated in the previous researches. While these analyses showed what production activities induced these health hazards caused by “primary” PM2.5, almost of these results doesn’t include the effects of “secondary” PM2.5. This study developed the secondary PM2.5 concentrations emitted on every industrial sector as a function point sources provided for both China and India. In this context, we used the Pangea spatial multi-process model: fresh sea-salts, aged sea-salts, terrestrial nitrates, primary biogenic emissions (arabitol, mannitol), marine biogenic emissions (methanesulfonate ions). These chemical parameters were used to explain PM2.5 concentrations of shipping in the world (up to 800 vessels sailing per day). PM2.5 concentration is an essential step. Numerous studies have performed on the identification of particles from terrestrial sources. The objective of this work is to fill the lack of knowledge about the impact of emissions from natural resources having transported over longer distances, versus formaldehyde that has a more local impact. Decomposing exposure per industrial sector shows petroleum and steel industry as the highest contributing industrial sectors for benzene, whereas the electricity sector and petroleum refining contribute most to formaldehyde exposures. The source apportionment identifies the main sources contributing to exposure at five locations of interest. Overall, this presentation demonstrates the relevance of addressing exposures both from an emitter perspective well-suitied to inform product oriented approaches such as LCA, and from a receptor perspective for health risk mitigation.

TU407
Non-targeted screening of DNA adducts as biomarkers for human exposure to PAHs in the environment with liquid chromatography tandem mass spectrometry
Y. Feng, C. Yao, Health Canada; W. Foster, McMaster University
Humans are constantly exposed to thousands of contaminants in the environment. Polycyclic aromatic hydrocarbons (PAHs) are a group of organic compounds containing two or more aromatic rings. They are released into the environment from both natural and anthropogenic sources such as combustion of organic substances and incomplete burning of coal, oil, gas, tobacco products and wood. PAHs are known to be bio-transformed by phase I metabolic enzymes to chemically reactive intermediates that may bind covalently to DNA to form DNA adducts that interfere with DNA synthesis and transcription, leading to DNA mutations and/or toxic effects. Furthermore, binding of electrophilic PAH metabolites to DNA is thought to be a key step in the initiation of cancer. Therefore, measurement of those DNA adducts could be an indicator or biomarker of human exposure to PAHs in the environment and of the dose of the ultimate reactive metabolite. Rapid non-targeted approaches are desired to explore a broader scope of new biomarkers associated with the contaminants of interest. In this study, we performed non-targeted metabolomics and genomics by using the full scan data to identify DNA adducts time consuming. In this presentation, we will report a non-targeted screening method for identification of covalent DNA adducts using a combination of neutral loss scan and product ion scan in a q-TOF system. The method was applied to non-targeted screening of DNA adducts in follicular cells from isolated ovarian follicles that were exposed to cigarette smoke condensate (CSC). Four DNA adducts, benzal[a]pyrene-7,8-dihydrodiol-9,10-epoxide-dG(PDPE-dG), phenanthrene 1,2-quinone-dG(PheQ-dG), BP[a]P-7,8-quinone-dG(BPQ-dG) and 4-aminobiphenyl-dG, were identified in the follicular cells. The results also revealed that two oxidative biomarkers, 8-hydroxy-2-deoxyguanosine (8-OH-dG) and 8-isoprostane (8-Isop), had strong correlations with the three DNA adducts, BP[a]P, BPQ-dG and PheQ-dG, suggesting a strong link between the formation of covalent DNA adducts and DNA damaging oxidative stress. The method has also been successfully applied to investigate the selectivity of chemicals to modify the xenobiotic enzymes on DNA sequence. The results showed that each chemical had a different selectivity when it modified the DNA bases. The method has been demonstrated to be a potential tool to provide screening of unknown DNA adducts as biomarkers of human exposure to the parent contaminants in the environment.

TU408
Global inter-comparison of polystyrene foam passive air samplers evaluating variability due to sampler design and analysis
L. D. Chin, Aalto University / RECETOX Research Centre for Toxic Compounds in the Environment; P. Bohlin Nizzetto, NILU - Norwegian Institute for Air Research / MILK; T. Harner, Environnement Canada / Air Quality Research Division; J. Klanoa, Masaryk University / RECETOX Research Centre for Toxic Compounds in the Environment; O. Armadon-Munoz, Universidad Autonoma de Mexico / Centro de Ciencias de la Atmosfera; B. Artizibilaz Zuhuaga, Universidad Nacional de Colombia Sede Manizales / Hydraulic Engineering and Environmental Research Group; M.Y. Tominaga, CETESB Companhia Ambiental do Estado de Sao Paulo; A.J. Sweetman, Lancaster University / Lancaster Environment Centre; B. Jimenez, IQOG-CSIC / Department of Instrumental Analysis and Environmental Chemistry; A. Dreyer, Eurofins GIA GmbH; M. Odabasi, Dokuz Eylul University; J. He, University of Nottingham Ningbo; W. Ma, Harbin Institute of Technology / China/International Joint Research Center for Persistent Toxic Substances (URC-PTS); J. Ma, Lanzhou University / College of Earth and Environmental Sciences; G. Zhang, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences / State Key Laboratory of Organic
Polyurethane foam passive air sampler (PUF-PAS) are the most commonly used passive air sampler for a range of semi volatile organic compounds (SVOCs) such as regulated persistent organic pollutants and polycyclic aromatic hydrocarbons, and emerging SVOCs (e.g. novel flame retardants, phthalates, current-use pesticides). PUF-PAS are part of global/regional air monitoring programs as well as in case studies around the world. While the majority of PUF-PAS use single double-bowl metal shielding, there is no standardized design applied in all studies in terms of bowl size, shape, deployment configuration. Many different PUF-PAS designs are used in regional or global programmes such as the Global Monitoring Programme under the Stockholm Convention and these data are compared for spatially/temporal trend analysis. Yet, no information is available on the comparability of data from all the different designs. We brought together 12 types of PUF-PAS samplers from around the world and deployed them in a multi-part inter-comparison in order to evaluate the variability in reported concentrations introduced by different elements of PAS monitoring. Three sets of PUF-PAS were deployed in Kjeller, Norway in 2015-2016, as follows: (1) 3-month deployment of 15 PAS provided by international research groups, and returned to their respective research groups for analysis for SVOCs – this provides information on the overall variability in global monitoring data introduced by differences in sampler configurations and analytical methods; (2) 3-month deployment of 15 identical PAS, which were then distributed to international laboratories for SVOC analysis, to isolate the influence of analytical variability; and (3) 3-month deployment of 15 different PAS and analysis at a single laboratory (RECETOX Trace Analytical Laboratories, Masaryk University) to isolate the influence of PAS design on data comparability. Results indicate that while differences in sampler design (in particular the spacing between the upper and lower sampler bowls) account for 50-100% differences in masses collected by samplers, the variability introduced by analytical methods still significantly exceeds this amount, and this effect should be carefully considered when evaluating and comparing global monitoring data.

**TU409**

**Microplastic Indoor Air Pollution Using a Simulated Breathing Mannequin**

N. van Alst, Aalborg University / Civil Engineering Department; A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; R.L. Jensen, Aalborg University; J. Vollertsen, Aalborg University / Civil Engineering Department

Extensive research has been performed on indoor air quality (IAQ) over the last decade in order to identify the mechanisms of exposure in indoor and surface environments, as well as determining particle types and sizes. However, microplastic research in indoor air has been lagging behind. With the strides in microplastic research in the last years renewed interest has now arisen on microplastics as a form of indoor air pollution. This research focuses on microplastics in indoor air, with emphasis on the potential exposure to humans as a result of inhalation. This is simulated using a mannequin set-up built to simulate the breathing of a human subject. The mannequin takes in air through the mouth, which is led through a copper pipe to the filtering unit. The copper pipe meets a filter holder on which a 0.8 µm custom-cut 20 mm SteriTech silver membrane filter appropriate for µFT-IR imaging analysis is mounted. This is connected to a dual piston pump which simulates natural breathing. Samples have been taken in actively lived in apartments, as well as varied locations within the universities' work environment. Samples have been divided up into continuous sampling and intermittent sampling under active living/working conditions. All samples have received active sampling for approximately 24h, either continuous or intermittent collection. In each environment a catalogue and accompanying material for spectral identification is kept of the interior. The aim of the research is to ascertain the contribution of materials from the indoor environment as a function of activity, and determine possible exposures as well as contamination levels coming from indoor air. For identification and quantification of microplastics contained in the samples, an Agilent Technologies micro-Fourier Transform Infrared (µFT-IR) imaging system equipped with a 128x128 Mercury Cadmium Telluride (MCT) Focal Plane Array (FPA) is used. Samples are directly scanned on the silver filter at 33.0 or 5.5 µm pixel resolution, providing microplastic detection down to 6-10 µm in particle size. After collection, data is exported to in-house developed software for obtaining polymeric composition and quantifying size and mass of all µFT-IR imaged microplastics. Analysis of samples is ongoing and scheduled to be completed by March 2018.

**TU410**

**Composite electrospun fibers based on sustainable and biodegradable polymers for monitoring air pollution**

A. Magazzùno, E. Zampetti, N. Pirrone, CNR-Institute of Atmospheric Pollution Research; G. Scarscia Magnozza, University of Tuscia-DIBAF; C. Di Natale, R. Paolese, University of Tor Vergata; F. De Cesare, University of Tuscia-DIBAF

Environmental monitoring is a growing concern in both developed and non-developed countries. Air quality monitoring is usually performed with specialized equipment and analytical methods by regulatory agencies and researchers. However EU projects guidelines report the need to involve also citizens in environmental monitoring, thus low-cost and easy-to-use technologies are required. To achieve this aim, novel sensors for environmental monitoring have been designed and developed to date to obtain reliable values comparable to those provided by standard methods and technologies. Currently, electrospinning is considered as one of the most versatile and inexpensive manufacturing technologies to develop new sensors to detect volatile organic compounds (VOCs) in the air. Sensors based on polymeric fibers look extremely attractive for the low cost and great versatility of the raw materials that can be easily tunable, according to the transducer used and the application of interest, taking part to the resulting sensing features (selectivity and sensitivity). Therefore electrospun nanofibrous and environmentally friendly materials have been designed and fabricated for detecting pollution. Electrospinning has been focused on the challenging goal of obtaining conductive sensors for the monitoring of air pollutants employing suitable scaffolds of eco-friendly (polyhydroxybutyrate) and sustainable (recycled) nanomaterials (polystyrene). Indeed biodegradability is a noteworthy feature to obtain sensing tools environmentally friendly and safe for health. However, sensors for gas monitoring must also be able to both persist intact for a useful shelf life and to preserve their sensing features over time, depending on the specific application and the working period. Finally, the selectivity of fibers can be tuned by introducing different functionalized macromolecules (Me-tetrapentaphosphorins) that are sensitive to several classes of gas and VOCs. The conductivity of the planned sensors has been implemented by adding conductive nanoparticles (e.g. graphene’s flakes). Rapid response, low cost, ease of fabrication, and compatibility with the wearable devices have made electrospun nanofibers excellent candidates to be used to develop sensors to detect nitrogen oxides and ammonia in traces and VOCs, mainly due to both high porosity and high surface of interaction. Therefore, the use of polymers obtainable from recycled and biodegradable plastics sounds to be a promising and alternative strategy for the development of smart scaffolding for air pollution monitoring. Keywords: advanced sensors, sustainable and biodegradable polymers, nanofibers, air pollution.
Kekulé resonance structures, 2) thermodynamic stability of all possible OH-PAH adduct intermediate, 3) electron density at each carbon on the PAH and 4) average local ionization energy (ALIE) at atom or bond sites. To evaluate the accuracy of these approaches, the predicted PAH-TPs were compared to published laboratory observations of major NPAH, OPAH, and OHPAH products in both gas- and particle-phases. We found that the Clar’s resonance structures were able to best predict the low level rings on the PAHs, but did not offer insights in terms of which carbon is most reactive. All other computational approaches provided specificity in their predictions, yet the ALIE approach was the most superior in accuracy, when compared to laboratory data. The high predictive capability of ALIE shows great potential for the prediction of the formation of previously unlisted PAH-TPs that are likely to form in the atmosphere. Furthermore, the results for the atmospheric chemists to prioritize which PAH-TPs should be synthesized to verify their presence in the environment; and the toxicologists to prioritize which PAH-TPs should be analyzed for their toxicity and potential human health implications. Future direction of the study is to expand the prediction to screen for PAH-TPs from other parent-PAHs as well as alkylated-PAHs.

TU413 Spatial distribution of gas-phase Polycyclic Aromatic Hydrocarbons along South America and Antarctica
A. Azevedo, Instituto Federal do Rio Grande do Sul; K.S. Miglioranza, University of Chile; M. Fernandez, Instituto de Estudios de Ecotoxicología y Contaminación Ambiental, Instituto de Investigaciones Marinas y Costeras; P.G. Costa, FURG / Escola de química e alimentos; R. Barra, Universidade de Concepción; O.P. Amarante Jr, IFMA / DAQ, F. Wania, University of Toronto at Scarborough / Physical and Environmental Sciences; G. Fillmann, Universidade Federal do Rio Grande FURG / Instituto de Geografia e Ambiente.
Polycyclic Aromatic Hydrocarbons (PAHs) are a large group of compounds with two or more condensed aromatic rings. These compounds are emitted from various sources to the atmosphere and some of them are known by their carcinogenic or mutagenic properties. However, qual-quantitative information is limited about PAHs in air, and normally rely on the availability of active sampling techniques, usually expensive and laborious, needing power source, inexistence in remote areas. Conversely, passive sampling allows easy and cheap handling atmospheric appraisal even in remote regions. Thus, the present study evaluated PAHs levels throughout the South American atmosphere employing XAD2-based passive atmospheric sampling (PAS). The Latin American Atmospheric Sampling Network (LAPAN) has begun in 2010 by deploying a pair of PAS containing one cartridge of XAD2 resin on each site. Resins were deployed for 12 months during 3 consecutive years at 42 sites (16 sites in Brazil and 26 distributed in Argentina, Chile, Peru, Uruguay, Venezuela and Antarctica) covering different backgrounds (rural, urban / industrial and remote). Passive samplers and XAD2 resins were prepared as described by Wania et al. (2003). XAD-2 resins were extracted by hexane:dichloromethane (1:1), purified and analyzed by gas chromatography/mass spectrometry using a Perkin-Elmer Clarus 500 gas chromatograph equipped with a 5 mm DB 5, 60 m column. Two PAHs were found: naphthalene, 2-methyl-naphthalene, 1-methyl-naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a)anthracene and benzo(ghi)perylene. Results, reported a presence of PAHs at all sites. HPAs with higher molar weight (low vapor pressure) were below the detection limit or levels were very low, such as the potentially carcinogenic benzo(a)anthracene and benzo(b)fluoranthene. The urban and suburban areas showed higher levels compared to remote regions. This is a long term study looking forward to appraise temporal trends to PAHs along South America atmosphere.

TU414 Importance of Dermal Exposure to Polycyclic Aromatic Hydrocarbons Derived from Barbecue Fume
J. Lu, S. Xie, Jinan University, C. Wu, L. Bao, Jinan University / School of Environment; S. Tai, Peking University / Laboratory for Earth Surface Processes College of Urban and Environmental Sciences; E. Y. Zeng, Jinan University / School of Environment.
Despite the ubiquity and carcinogenicity of polycyclic aromatic hydrocarbons (PAHs), its dermal absorption for the general population has not been adequately represented. Aiming to verify the importance of dermal absorption for PAHs, a case study of BBQ in Guangzhou, China was done. Urine samples were collected approximately 17 h before exposure until 35 h after exposure from 20 participants and analyzed for nine hydroxyl (OH)-PAHs. Air, food, and cotton clothing samples were analyzed for 16 PAHs. Based on the occurrence of atmospheric PAHs, dermal absorption of low molecular-weight PAHs was greater than inhalation intake. In addition, the net excreted amounts of OH-naphthalene, OH-fluorene, OH-phenanthrene, and OH-pyrene via dermal contact were 367, 63, 98, and 28 ng respectively, comparable to those via combined dermal and inhalation exposure, which were 453, 98, 126, and 38 ng. The ratios of excretion to intake via dermal contact were 0.11, 0.036, and 0.043 for fluorene, phenanthrene, and pyrene, respectively, higher than those for inhalation (0.097, 0.016, and 0.025). These results indicate that dermal absorption is a significant exposure route of PAHs. In the case of BBQ fumes, dermal absorption is a more important pathway for intake of low molecular-weight PAHs than inhalation.

TU415 EDS Mapping of Particles As A Component of Lichen Biomonitoring in Seattle, Washington
G T Guddal, Western Washington University; J. Miller, A. Johnson, Western Washington University / Environmental Sciences Department; R. Sofield, Western Washington University
Lichen are increasingly popular medium for conducting air quality monitoring due to their sensitivity to SO2 and NOx, as well as their biodegradation of airborne material. This study incorporates characterization of particulate matter (PM) on the surface of lichen Ramulina furcata to map exposure to air pollution in three industrial clusters in Seattle, Washington, USA. The PM was characterized using scanning electron microscopy with energy-dispersive X-ray spectroscopy mapping to determine PM size and composition. We also measured bioaccumulation of certain PAHs in the lichen and biotic markers, chlorophyll degradation, malondialdehyde, and aspecific,. Principal components analysis has identified which geographic locations and particle types correlate the strongest with increased metal accumulation and physiological response in the lichen.

TU416 TBARS in horse hair as an indicator of oil industry pollution
M. Kovačević, Department of Biology, University of Osijek; T. Plavac, B. Kutuzović Hackenberger, University of Osijek / Department of Biology
Air pollution is a major problem today. Although there are many tests that measure the presence of certain substances in the air, it is important to measure the impact of various pollutants on living organisms as well. Horses that spend time outdoors are exposed to environmental influences, and some of them are measurable in horse hair. The aim of this study is to assess how pollutants of the oil industry affect biological markers in permanent horse hair from mane and tail and whether the concentration of thiobarbituric acid reactive substances (TBARS) can be used as biomarker of oil industry air pollution. The horse hair samples from mane and tail were collected from two areas. One near Slavonski Brod, where an issue of air pollution is present due the outdated refinery plant in Bosanski Brod, and the other near Osijek where no apparent air industry pollution is present. The concentration of TBARS in samples was measured fluorometrically. The samples were cut into segments to detect differences in duration of exposure through the age of hair. The concentration of TBARS was significantly higher (p<0.005) in horses exposed to polluted air (Slavonski Brod site). When segments were analysed according to the age of hair it was noticed a constant difference in concentration of TBARS between roots and top for mane and tail. A significant correlation between age of hair and concentration of TBARS was noticed. Although further research is needed, a concentration of TBARS in horse hair could serve as a simple and inexpensive method for monitoring air pollution by oil industry.

TU417 Morbidity for environment-related diseases in La Spezia, northwest Italy: an epidemiological analysis on hospital discharge rates
F. Lucaroni, University Rome Tor Vergata / Department of Biomedicine and Prevention; A. Pietroiusti, University of Rome Tor Vergata / Department of Biomedicine and Prevention; C. Alessandroni, C. Ambrosone, L. Palombi, University Rome Tor Vergata
Background. La Spezia Province, northwest Italy, is a potentially high risk area because of the massive presence of industrial and harbor activities. Only controversial evidence of their health impact in the area is available at the moment. Therefore, a comprehensive survey on potentially environment-related disease would be really useful. Methods. Liguria Region hospital discharge records from 2001 to 2013 have been collected. Only admissions for cardiovascular disease, respiratory disease or neoplasms as primary diagnosis were included. Hospital discharge rates, standardized by age and compared with Regional mean, were represented using geographic maps with a color scale identifying different disease distribution. For those disorders showing significant difference with regional mean, disease distribution was compared with emissions of air pollutants, estimated by Lichens biomonitoring. Results. La Spezia Province Hospital Discharge rates for potentially environment-related disease were significantly different if compared with those of the Liguria Region. Malignant melanoma, chronic bronchitis and myocardial infarction rates were higher both in men and women (with a percentage increase of 84% and 87%, respectively, for malignant melanoma; +22% and +47% for chronic bronchitis and +40% and +41% for myocardial infarction). Conversely, hospital discharge rates for diabetes and hypertensive cardiopathy were lower than Liguria Region: -50% among males and -49% among women for the first and -56% and -54%, respectively, for the second. Comparing these results with Lichens maps, no evidence of a clear correlation between emissions of air pollutants and regional distribution of diseases was available. On the contrary, diseases differing the most
from Regional mean were mainly distributed in areas with scarce anthropic activity. **Conclusions.** No clear morbidity trend is identifiable for La Spezia Province from 2001 to 2013. Also disorders belonging to the same pathological class –like myocardial infarction and hypertensive cardiopathy - showed a different behavior. Comparing results with Lichen maps helps putting excesses of morbidity into a Regional context, being cautious to clearly correlate such disease with industrial and Harbour activity. Indeed, most of the disorders showed the higher increases in areas with less signs of anthropic activity, according to Lichens biomonitoring.

**TU418**  
Risk Assessment of Polyethylene Residues and Organoleptic Attributes of Bambara nut puddling (Okpua) Samples prepared using Alternative Cooking Materials

T. Oitojtu, University of Nigeria Nsukka / human nutrition and dietetics; O. Oitojtu, federal University Wukari / Department of Biochemistry; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; S. Baijer, Federal University OyeEkiti / Agronomy

Polyethylene residues are chemical components that are left over as monomers and end products after the thermal degradation of polyethylene. However, the use of plastic as cooking materials in bambara nut puddling (Okpua) a well-cherished food, especially among the inhabitants of the Eastern part of Nigeria may pose more danger than envisaged. The use of banana leaves in cooking food has been in existence in Nigeria before the introduction of the technological cooking materials such as polyethylene, cellophane plastic, tin and foil. In this study, we evaluated the risk assessment of polyethylene residues (volatile organic compounds - VOCs) and organoleptic attributes of Bambara nut puddling (Okpua) samples prepared using alternative cooking materials. Purge and trap method using Gas Chromatography and Mass Spectrometry instrument were used to estimate the concentrations of VOCs in the different puddling cooked using some alternative cooking material (cellophane, tin, foil and plastic) while banana leaves were used as control. Organoleptic evaluation was done using A-Point Hedonic Scale, standard methods and ANOVA was used to compare means of the results. The result showed the presence of some Volatile Organic Compounds such as Argon, Allene, Acetic acid, Propane-1-ol, difluoromethane, Hexanoic acid, Amyl nitrite, Toluene, Butenifluorite, 2-Butenal, Thiraene, Nonanoic acid, Ethylenediamine, Furfural, Hydrogen azide, 2-pentene, Formic acid, and acetic acid; with Acetic acid occurring the most and Argon, Allene, and Difluoromethane occurring the least. Pudding made with cellophane had the highest VOCs with 45% D-mannohepitoule, 45% hexanoic acid, 25% propane-1- ethenylthio and had other VOCs ranging from 4-9%. All the cooking materials had hexanoic acid at high concentrations of 25-42%. The result also showed that acetic acid and 2-butenifluorite ranged from 4-7% in all samples except Banana leaves puddling. Organoleptic evaluation of the Bambara puddling samples with different alternative cooking materials were generally acceptable (p<0.05) but pudding wrapped with banana leaf was significantly (p<0.05) rated low for colour and taste while others were comparable (p>0.05). In conclusion, bambara nut puddling cooked with alternative cooking materials contained polyethylene residues.

**TU419**  
SETAC Human Health Risk Assessment Interest Group

B. Mulhem, Ensafe Inc.

**Fungicides - an overlooked compound group? Fate, effects, risk assessment and mitigation (P)**

**TU420**  
Ecological risk assessment of conazole fungicides in arable soils of the Czech Republic

J. Vasickova, M. Hvezdova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); P. Kosobuva, Central Institute for Supervising and Testing in Agriculture; K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IF-A-Tulln); Z. Simk, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX

Application of pesticides, including conazole fungicides (CFs) is an indispensable part of modern agricultural management, contributing to food security and safety. Conazoles are a class ofazole-based fungicides, commonly used to prevent fungal growth on turf grass and agricultural crops. CFs are still widely used despite their reported ecotoxicity in water, chronic toxicity to mannnals with hepatotoxicity, carcinogenicity, reproductive toxicity and endocrine disruption. For example, in the EU classification, epoxiconazole and flusilazole are suspected carcinogens [1]. Present of such compounds in arable soils represents potential short- or long-term environmental threat with a wide range of possible negative impacts on ecosystem services and health. Hence, risk assessment considering various ecotoxicity groups of vertebrates, invertebrate and plant species, should be performed. The objective of the present work was to assess the ecological risks of conazole fungicides based on the data from the comprehensive survey of pesticide residues in 75 agricultural topsoil floodplain locations in the Czech Republic acquired in early 2015 [2]. In this study, 51 currently used pesticides and 9 transformation products were analysed by multi-residue pesticide analysis on LC-MS/MS after soil QuEChERS extraction. The material indicated that over 70% of soils contained at least one CF and the total concentration of CFs exceeded 0.01 mg/kg in 53% of soils. Epoxiconazole and tebuconazole also frequently exceeded 0.01 mg/kg (in 25% and 20% of the samples, respectively). The highest concentrations of CFs were epoxiconazole (48% of soils) and tebuconazole (36%), followed by flusilazole (23%), prochloraz (21%), propiconazole (13%), cyproconazole (8%) and difenoconazole (7%). Overall, the CFs fungicides are of environmental concern because they exceeded risk based thresholds, tend to form long-term residues in soil and rank among suspected carcinogens and endocrine disruptors. [1] EU pesticide database - ec.europa.eu/food/plant/pesticides/eu-pesticidesdatabase. [2] M. Hvezdova, et al., Sci. Total. Environ., vol. 613–614, pp. 361–370, 2018.

**TU421**  
Concentration- and time-dependent dissipation, partitioning and plant accumulation of selected fungicides, insecticide, herbicide and transformation products in sand and soil

N. Newiirthová, Masaryk University; Z. Bílková, Masaryk University / RECETOX; J. Vasicková, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX; L. Bielsk, Masaryk University / Faculty of Science RECETOX

In this study, the dissipation and partitioning dynamics and the extent of biotakeup was measured and modeled for selected hazardous current-used fungicides (prochloraz, tebuconazole, flusilazole, epoxiconazole), insecticide (chlorpyrifos), herbicide (pendimethalin) and for a transformation product (2-hydroxyatrazine) in agricultural soil and quartz sand as representatives of a real and a worst-case scenario. Dissipation, uptake to Lactuca sativa and the freely dissolved compound along with its metabolite, abnormally normalized sorption coefficients (Kd) were determined on day 12, 40, and 90 following the application of compounds at three fortification levels (0.1 - 1.0 - 10 mg/kg). Dissipation of tested compounds differed in soil and sand and was influenced by compound concentration. 2-hydroxyatrazine showed the longest persistence in soil among the tested compounds. The four fungicides showed very similar dissipation patterns and were more persistent in sand than in soil which implies that their main elimination mechanism in the environment is biodegradation. Plant roots were shown to accumulate higher amounts than shoots with root-to-shoot translocation factors (TFs) of 0.007-0.14 where the extent of root uptake was driven by compound partitioning. This was evidenced by the ability of Cmax to reliably (r² = 0.94) predict root uptake. Concentrations of metabolites did not exceed the maximum residue levels (MRLs) for lettuce. Kd values were in the range of literature values and were shown to increased (from 0 day to 40 day) as well as decreased for some compounds (from 40 day to 90 day) with time probably as a result of compound sequestration and competitive sorption, respectively. From the results, it follows that the tested compounds pose limited risks when presented in the soils for a given timeframe, but shown to be not persistent (except for 2-hydroxyatrazine), b) to accumulate in lettuce to extents below MRLs, c) to sorb effectively to soil, even in the presence of other co-solutes.

**TU422**  
Evaluation of pesticides and fungicides transport using passive sampling devices in a vineyard catchment in South West France

J. Gaillard, Université de Bordeaux / EPOC UMR 5805; M. Dévier, University of Bordeaux / EPOC / LPTC UMR 5805 CNRS; K. Le Menach, P. Pardon, UMR CNRS EPOC Université Bordeaux / EUMR 5805; G. DUPORTE, Université de Bordeaux / EUMR 5805; F. Macary, Irisée Bordeaux; H. Budzinski, University of Bordeaux.

In vineyards of South West France, fungicides account for nearly 8 out of 10 pesticide applications which increases the likelihood of chronic exposure in adjacent ecosystems. The objective of the present study was to investigate the dynamics of pesticides and fungicides from agricultural drainage ditches to a third order stream in a vineyard catchment. Monitoring was a combination of passive and grab water sampling. Six sites with continuous-flowing catchment were monitored during a year using polar organic chemical integrative sampler (POCIS) retrieved monthly together with grab water samples collected monthly or bimonthly. Four sites with intermittent-flow were monitored using grab water samples only. Passive samplers such as POCIS enable the improvement of limits of quantification (LOQ) and estimation of time-weighted average concentrations over the exposure period for polarographic compounds or non-polar compounds. The 50 pesticides were targeted including 23 fungicides currently applied in the studied catchment. Extracted samples were analysed by liquid chromatography-tandem mass spectrometry (LC-MS/MS) and gas chromatography-tandem mass spectrometry (GC-MS/MS). Among the currently used pesticides in the catchment, preliminary results obtained from a sampling campaign conducted in spring allowed the quantification of 19 fungicides, 3 herbicides and 1 insecticide in passive samplers. In water samples, 9 fungicides and 1 insecticide were detected. Highest concentrations (> 1 µg/g) were measured for the fungicides benalaxyl and dimetomorph. Fungicides such as cyproconil, kresoxim-methyl and iprocarb
were detected in passive samplers but were not detected in water samples suggesting the importance of combining sampling techniques to provide a more complete assessment of fungicide exposure in vineyard catchments.

**TU423**

*Assessment of secondary exposure to fungicide residues in fruit-growing workers where apples were a main crop.*

G. DUPORTE, J. Gaillard, Université de Bordeaux / EPOC UMR 5805; E. Barron, University of Bordeaux, CNRS / EPOC UMR 5805; K. Le Menach, P. Pardon, UMR CNRS EPOC Universite Bordeaux / EPOC UMR 5805; I. Baldi, University of Bordeaux / ISPED, EPIFENCE; F. Macary, Inria Bordeaux; M. Dévier, University of Bordeaux / EPOC / LPTF UMR 5805 CNRS; H. Budzinski, University of Bordeaux.

European Union countries have about 12 million agricultural holding, and approximately 172 million hectares (39% of the total European land surface) of agricultural areas. Pesticides are used extensively in agricultural production to prevent pests, diseases, weeds or other plant pathogens to reduce yield losses and to guarantee a good harvest. In the recent decades, numerous studies have suggested adverse health effects associated to long-term pesticide exposure. Serious concerns have been raised about health risks resulting from occupational exposure. Nevertheless, the knowledge of occupational exposure levels and determinants to pesticides are still limited. The CANEPA project (Cancers and Exposures to Agricultural Pesticides) aims to characterise external contamination of agricultural workers and environmental contamination by pesticides in arboriculture. In this work, we assessed the dietary intake of Korean victims who were exposed to the fungicide Iprodione. The study was mainly focused on two fungicides (captan and dithianon), extensively used in apple growing, and their metabolites. High sensitive analytical methods were developed and validated, in this work, for the different collected samples based on gas or liquid chromatography coupled to hybrid high resolution mass spectrometry and to tandem mass spectrometry. (GC-QTOF-MS and HPLC-ESI-MS/MS). Levels of pesticide residues and source characterisation will be presented. These findings provide a better understanding of current practices and may help for reducing pesticide occupational exposure and health risks for fruit-growing workers.

**TU424**

*Intra-tracheal administration of the disinfectant, chloromethylisothiazolinone/methylisothiazolinone (CMIT/MIT), in a mouse model to evaluate a causal association with death.*

Y. Park, GLP Center, Catholic University of Daegu / APT; H. Kim, Graduate School of Medical Health Science, Catholic University of Daegu; B. Kang, Catholic University of Daegu, Graduate school of toxicity assessment. CMIT/MIT was instilled (in the trachea) with a narrow range of CMIT/MIT exposures showing a visible boundary between the few available toxicity tests and the abundant epidemiological data, thus making it difficult to establish a cause-and-effect relationship. Therefore, this study was carried out to investigate any potential associations between CMIT/MIT exposure and death. Methods: Groups of experimental and control C57BL/6 mice were instilled in the trachea with various concentrations of chloromethylisothiazolinone/methylisothiazolinone (CMIT/MIT), using a visual instillbot. CMIT/MIT was instilled over a period of 3 days and 8 weeks, respectively, to achieve acute and chronic exposures. A threshold dose-response model was applied for estimating the threshold level as one line of evidence for a causal association between CMIT/MIT and death. Results: An acute exposure of 1.2 mg/kg/day of CMIT/MIT was estimated to reflect the threshold for death. The dose-response curve with this threshold showed a very steep slope and a narrow range of CMIT/MIT exposures. A narrow range of CMIT/MIT exposures, in particular, indicated an evident boundary between survival and death, thus implicating a strong causal association. A similar threshold dose-response relationship observed following acute exposure was also seen following chronic exposure to CMIT/MIT. Airborne disinfectant exposure was visible as minimal or mild lung damage with no fibrosis, as shown by histopathological tests. However, many observations are considered to be functional respiratory tract, as observed in necropsies of the mice that died due to CMIT/MIT exposures. Conclusions: There are two strong lines of evidence for a causal association between death and CMIT/MIT exposure: 1) the threshold dose-response curve, with a very steep slope and a narrow range of CMIT/MIT exposures showing a visible boundary between survival and death, and 2) functional respiratory tract failure except lung fibrosis. Thus it is concluded that CMIT/MIT exposure would cause the death without lung fibrosis.

**TU425**

*Genotoxic response and alteration of intracellular redox balance in Hep-2 cell line by exposure to Iprodione.*


The use of fungicides represents one of the most important factors in the control of pests and diseases, which affects the production systems of fruits and vegetables. It is known that most fungicide residues remain stable in food for long periods of time, increasing exposure risk for the general population. The aim of the present study was to evaluate the oxidative damage, the antioxidant response and the genotoxic effect in a human cell line (HeP-2) against the exposure of sublethal concentrations of the fungicide Iprodione. For this proposal, we determine the content of protein carbonyls a marker of oxidative damage, the equivalent content of glutathione (GSH), the activity of antioxidant enzymes superoxide dismutase (SOD) and catalase (CAT) and from detoxifying enzyme GSH-S-transferase (GST), in 3 concentrations of Iprodione (1.5, 7 and 25 μg/ml). The cell division index, the replication index, the frequency of chromosomal aberrations and micronuclei were also determined in the presence of 7.5; 17.5 and 25 μg/ml of Iprodione. The activity of SOD decreased significantly 40% (p < 0.05) to 25 μg/ml of Iprodione, while no effect on the activity levels of CAT and GST was observed. The content of protein carbonyls increased 30% (p < 0.001) at the highest concentration of Iprodione tested. In addition, it was observed that Iprodione induces triphoric and micronucleus divisions at 17.5 and 25 μg/ml with all concentrations tested. Both the index of division and the index of replication indicate that the cells maintain their proliferation capacity, which allows to study the biomarkers of genotoxicity in this system. These results confirm that Iprodione produces genotoxicity and an alteration in the redox equilibrium at the concentrations tested, which indicates the potential risk of exposure to this xenobiotic.

**TU426**

*Toxicological effects of commercial fungicides on the earthworm Eisenia fetida (Savigny, 1826): laboratory and field investigations.*

T. Campani, I. Caliani, C. Pozzuoli, L. Poggioni, University of Siena / Department of Physical, Earth and Environmental Sciences; S. Casini, University of Siena / Science Park. The cells were used as an animal model to test the effects of the fungicide Iprodione on soil microorganisms. The use of plant protection products in agriculture can affect non-target soil organism and have a negative effect on the health of the ecosystem. In particular, information on toxicological effects of fungicides are very poor or absent, despite their widespread use. The aim of this study was to evaluate the potential toxic effects of 4 commercial fungicides (Prosaro®, Amistar®, Mirador® and Icarus®) on the earthworm Eisenia fetida (Savigny, 1826). Species. We choose commercial products with the aim of testing the simoultaneous effect of active principles and additives present in the products. Laboratory experiments were conducted using the filter paper test (FPT): E. fetida was exposed to increasing concentration of Prosaro® or Amistar®, being the highest dose of treatment the recommended one for use in wheat farming. Field investigations were conducted transplanting E. fetida in cages in the soil of wheat and durum wheat fields before and during treatment with different combinations of the 4 fungicides. E. fetida specimens from laboratory and field work were analysed to evaluate vitality, potential neurotoxic effects (inhibition of acetylcholinesterase activity (AChE)), phase II enzymatic defense (glutathione S-transferase (GST)), oxidative stress (lipid peroxidation (LPO) and catalase (CAT) activity), genotoxic effects (Comet assay) and effect on the immune system (lysozyme activity). Laboratory studies with Prosaro® and Amistar® showed alterations in organism’s vitality which increased with increasing treatment doses. Significant alteration of phase II metabolising enzymes (GST induction) and significant DNA fragmentation (Comet Assay) with respect to controls were detected at environmentally relevant doses of Prosaro®. Data from the field study further underlined a statistically significant induction of GST in earthworms transplanted in the fields treated with Amistar® alone and Amistar®+Prosaro®. This study represents a first step towards a better understanding of commercial fungicides toxicological potential to non-target organisms. Data obtained indicate that deeper investigations are needed which should include long term artificial soil tests (AST) and further field studies.

**TU427**

*Potential Salinity Enhanced Impacts of the Phototoxicity of the Fungicides to Inland Silversides, Menidia beryllina.*

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Dichloran and chlorothalonil are two active ingredients in fungicides commonly used in the United States that readily undergo photolysis in the presence of sunlight. Both pesticides have reported half-lives in seawater and freshwater. While the rate of degradation and the half-life of dichloran is impacted by the seawater chemistry (7.5 hours), the distribution of intermediate products is altered significantly; 2-chloro-1,4-benzoquinone forms at nearly double the concentration in seawater as opposed to freshwater. Chlorothalonil quickly degrades to 4-hydroxychlorothalonil via soil degradation and hydroxycytochlorothalonil can desorb back into the water column where it can be photochemically degraded. The degradation rate and half-life of hydroxychlorothalonil is very short, but differs significantly between freshwater (32.5 min.) and seawater (301 min.). Both dichloran and hydroxychlorothalonil have similar proposed photodegradation pathways, therefore the potential for enhanced phototoxicity due to salinity variation is possible. Dichloran has shown to be phototoxic to invertebrates at concentrations as low as 0.05 mg/L, while >90% mortality at 0.75 mg/L. Adverse sub-lethal impacts have also been observed, such as an upregulation in the CCL28 and PTGS2 genes. The effects of salinity on chemical toxicity may warrant changes to future chemical assessments.

**Prioritisation and Intelligent Testing of Pharmaceuticals in the Environment (P)**

**WE001**

*Development of a modelling framework for estimating the sorption of pharmaceuticals in soils*

L. Carter, University of York / Environment Department; J. Wilkinson, The University of York / Natural and Built Environments; A. Boxall, University of York / Environment Department

Isoniazid pharmaceuticals comprise a significant and increasing proportion of chemicals used in Europe. At typical environmental pH, isoniazid pharmaceuticals can become charged. Speciation can alter the fate and behaviour of a chemical in the environment including its sorption potential to soils and sludge. It is essential that the behaviour is recognised within chemical risk assessment and predictive approaches are able to account for how speciation alters chemical sorption. Several authors have proposed approaches to predict the sorption of isoniazid chemicals in soils. However, these models are typically based on training sets containing a multitude of organic chemicals and their ability to predict isoniazid pharmaceutical sorption specifically needs to be evaluated. We therefore evaluated a range of predictive approaches, that take into account sorbent properties (i.e. soil characteristics), for their suitability for estimating sorption of pharmaceuticals in soil. The evaluations were done using a database of high quality experimentally-determined pharmaceutical sorption coefficients provided by industry partners. Models developed for specific classes of isoniazid chemicals (i.e. cations or anions) performed better in comparison to simple generic models, which assume that hydrophobicity is the key sorption mechanism and neglect to take into account of the effects of chemical speciation. Nevertheless, model predictions for anionic pharmaceuticals still performed poorly (r² < 0.5). Sorption coefficients for organic cations were typically within an order of magnitude of experimental values whereas sorption was conserved as the balance of sorption to organic matter and to clay minerals. As sorption of neutral and anionic compounds were not well explained by the evaluated models, further model development was required for adequate prediction of soil sorption coefficients for these classes of molecule. A decision tree framework to guide the selection of appropriate sorption models by taking into account soil pH and ionisable functional groups has been created. This incorporates previously published models that performed well in our analysis and the development of new sorption models. Work is currently on-going to review sludge sorption models and will be presented. The authors acknowledge EU/EEPPIA Innovative Medicines Initiative Joint Undertaking (iPIE grant n° 115735) for the financial support.

**WE002**

*Photochemical transformation and intermediate formation processes in surface waters, in the context of climate change*

D. Vione, M. Minella, C. Mineo, University of Torino / Chemistry

Sunlight illumination of surface waters induces several photochemical reactions that play a key role in water quality and aquatic life. Sunlight affects the rate and extent of photo reactions leading to alteration in chemical speciation of pharmaceuticals, as well as to the formation of toxic or mutagenic intermediates. The aim of the study is to assess the photochemical processes involving pharmaceuticals in freshwater environments, and to draw conclusions on the environmental implications of these processes.

Photochemical reactions of pharmaceuticals in surface waters involve different processes: 1) direct photolysis of the target molecules; 2) indirect photolysis, i.e. photochemical reactions involving other species present in the water; 3) photodegradation of pharmaceuticals, which involves the formation of photoproducts and/or phototransformation reactions. These processes involve both the direct photolysis of the target molecules (directly triggered by absorption of sunlight, if any), and their indirect or sensitised photolysis. In the latter case, sunlight is absorbed by naturally-occurring photosensitisers (e.g. chromophoric dissolved organic matter or CDOM, nitrate and nitrite). Sensitised photolysis of pharmaceuticals is more complex and involves multiple phototransformation reactions. The phototransformation intermediates are involved in both photochemical reactions and environmental processes such as the release of pollutants into the environment, the formation of mutagens and toxic compounds.

**WE003**

*How Pharmaceutical Industrial waste can make your medicines ineffective*

N. Verma, Baddi University of Emerging Sciences & Technology / Pharmacy

Spread over 380 square kilometres in Himachal Pradesh’s Solan district, the Baddi-Barotiwala-Naggar (BBN) pharmaceutical industrial area is one of India’s largest pharmaceutical manufacturing hubs. The region hosts around 500 small, medium and large pharma units and accounts for 35 per cent of Asia’s total medicine production. But rapid industrialisation and a lax attitude towards safe disposal and management of pharma waste now concern about the effects of pollution on the environment and health. Liquid waste from these units is also discharged through pipes and other outlets that open behind the plant or run underground and open into bushy areas. This released wastewater accumulates in in or flows through nullahs, canals and rivulets into the Sisar river. Effluents are also injected into the ground at night by digging bore wells or released during rains. Due to such practices the BBN region suffers from both terrestrial and aquatic pollution. Many companies manufacture formulations, or finished products such as tablets and syrups. Some companies also manufacture active pharmaceutical ingredients (APIs) or the main biologically active ingredient used in formulations, including antibiotics. These APIs can enter the environment due to insufficient treatment or improper disposal of waste and weak environmental regulations. They are among environmental persistent pharmaceutical pollutants which have not degraded completely during treatment. They may influence the genetic makeup of bacteria, leading to the survival of resistant bacteria and spread of antimicrobial resistance (AMR), a public health threat. The result of our study showed that all gaps leading to the release of
APIs in the environment are plugged. The discharge of pharmaceutical effluents should take place through proper waste management techniques and stringent environmental regulations. Currently, effluent standards are limited to chemical contaminants such as heavy metals. The government must adopt a new AMR-centric approach of waste management which considers APIs as a chemical contaminant. Laws must be made to ensure that there are no APIs in treated effluents. The government should support small-scale manufacturers to install and implement environmentally sound waste treatment and disposal technologies.

We evaluate the accuracies and defaults are, at times, not representative of actual environmental conditions. The active ingredients in pharmaceuticals are discharged into the aquatic environment after use mainly through sewage treatment facilities. There is concern about adverse effects on wildlife due to the possibility of the presence of highly susceptible species. However, we still know little about what kind of impact on wildlife in the environment. Based on these backgrounds, we set up environmental impact assessment methods for the pharmaceuticals according to AMED’s strategy and evaluated the risks. We have measured the environmental concentrations (MEC) of 31 kinds of active ingredients in marketing medicine, using liquid-chromatography with mass spectrometry, in representative seven urban rivers in Japan, once every four seasons in 2015-2016. The maximum detected concentrations of the active ingredients exceeded 100ng/L are shown below.(olmesartan (57 ng/L), valsartan (480 ng/L), ibandronate (1 ng/L), esomeprazole (117 ng/L) for antithrombolytic agent, and sulpiride (546 ng/L) for antipsychotic agent, clarythromycin (445 ng/L) for antibiotics, and ketoprofen (150 ng/L) for analgesic/antipyretic agent, bezafibrate (200 ng/L) for hyperlipidemia treatment drug, crotamiton (845 ng/L) for antipruritic agent. Among target ingredients, the detect concentration of active ingredient contains pharmaceuticals for the lifestyle-related disease, hypertension and lipid metabolism related disease, tended to be higher. The concentrations in the winter or spring was observed a higher tendency, but the detected concentrations of active ingredients greatly varied depend on river according to the type of lifestyle and the type of pharmaceuticals been spread. It was indicated that the detected active ingredients were derived mainly from sewage treatment water as it depends on the concentrations of sucralose measured at the same time. The pharmaceuticals whose maximum detected concentrations of active ingredients in each river water exceeded the predictive environmental concentrations (PEC) were five ingredients of candesartan, olmesartan, lorazepam, rosvastatin and epinastine, even when the dilution ratio was doubled. This result suggests that in some circumstances it is necessary to consider the dilution effect in the environmental fate assessment which sets it. Regarding the health effects on humans, the actual concentration for each daily minimum dose for each pharmaceutical ingredient was from 0.086% of lorazepam to 0.000001% of chloric acid.

Evaluation of simple exposure models used for environmental prioritisation of active pharmaceutical ingredients

J. Wilkinson, The University of York / Natural and Built Environments; A. Boxall, L. Carter, University of York / Environment Department; E. Burns, University of York

Targeted quantification using analytical methods such as high performance liquid chromatography followed by tandem mass spectrometry (HPLC-MS/MS) are effectively used to monitor trace-levels (ng/L) of active pharmaceutical ingredients (API) in the aquatic environment. However, as more than 1500 chemicals are currently in-use as pharmaceuticals, the high cost of HPLC-MS/MS prohibits its widespread use in the monitoring and prioritisation of APIs. Predictive exposure models may offer cheaper treatment water as it depends on the concentrations of sucralose measured at the same time. The pharmaceuticals whose maximum detected concentrations of active ingredients in each river water exceeded the predictive environmental concentrations (PEC) were five ingredients of candesartan, olmesartan, lorazepam, rosvastatin and epinastine, even when the dilution ratio was doubled. This result suggests that in some circumstances it is necessary to consider the dilution effect in the environmental fate assessment which sets it. Regarding the health effects on humans, the actual concentration for each daily minimum dose for each pharmaceutical ingredient was from 0.086% of lorazepam to 0.000001% of chloric acid.

Expert System to Inform BCF Testing Strategies for Pharmaceuticals

A. Agar, IBACON GmbH / Environment Department; L. Carter, University of York / Environment Department; P. Andrews, A. Nellis, SimOmics; S. Owen, Astazeneca / Safety Health Environment; J. Snape, Astazeneca UK Ltd. / AstraZeneca Global Environment; J. Timmis, SimOmics; A. Boxall, University of York / Environment Department

An important part of the environmental risk assessment (ERA) of pharmaceutical ingredients is the identification of the persistent, toxic and bioaccumulative properties (PBT assessment) of the molecule. Regulations and guidelines on how to conduct this assessment and what empirical data are required to do so are increasingly complex. Currently a large number of fish are used as part of the ERA process, particularly for experiments to determine the bioconcentration factor (BCF), even though research developments and guidelines already contain opportunities to significantly reduce the number of fish used via alternative methods. To reduce the cost and complexity of BCF testing an expert system software tool to support the PBT assessment of pharmaceutical ingredients by interpreting European regulatory needs and considering existing guidelines and the wider literature. The system generates transparent and evidence-based compound specific PBT assessment reports and BCF testing strategies if testing is required. In our strategy, the P and T Assessments are conducted before the B assessment because the latter is currently only required to be conducted to categorise the compound as PBT or vPvB. Thus empirical BCF values are not always required as decisions are made according to specific trigger values which are either exceeded by a compound or not. This means that in many cases the use of appropriate BCF prediction models prevents the need for experimentation. If a fish BCF test is required, our tool suggests an experimental design with the ultimate aim of reducing the number of fish used by testing a small number of test organisms needed without sacrificing the test validity criteria. The novelty of our system is that it illustrates, in a transparent manner, how the system made its decisions by incorporation of the argumentation tool ArtroPro. This tool visualises the system’s decision incorporating what regulatory and guideline
background was used to support that decision and what data, modelling approaches and assumptions were used in addition to the sources of data. Preliminary analysis of those compounds for which environmental fish BCF data are available in the literature against our new strategy revealed that if our strategy was followed in at least 19% of these cases an empirical study would have not been required.

**WE008 Development of a quantitative Adverse Outcome Pathway-informed model to predict the risk posed by mixtures of non-steroidal anti-inflammatory drugs to fish**
P. Marmon, J. Kayode, Brunel University London / College of Life Sciences; S. Owen, AstraZeneca / Safety Health Environment; L. Margiotta-Casaluci, Brunel University London / Institute of Environment, Health and Societies

The presence of low concentrations of non-steroidal anti-inflammatory drugs (NSAIDs) in the aquatic environment has raised the concern that chronic exposure to these compounds may cause adverse effects in wild fish populations, similar to those observed in human patients. This potential scenario has led to the inclusion of diclofenac in the European Union Watch List of emerging pollutants. Although the effects of diclofenac in fish have been investigated in over twenty published studies to date, the complexity of NSAIDs toxicology is such that many uncertainties still exist about the significance of those findings for environmental risk assessment. We hypothesise that the perturbation of cyclooxygenase (COX) activity in healthy fish tissues is the leading cause of adverse effects, as it is in humans. On the basis of this mechanistic starting point, we propose a quantitative Adverse Outcome Pathway-informed approach to the toxicodynamic aspects of NSAIDs toxicology. After extracting all NSAIDs toxicity data available in the scientific literature, we applied drug uptake models to predict the plasma concentrations at which different effects would occur in laboratory studies. As all NSAIDs act by inhibiting the enzymes COX1 and/or COX2, we applied mixture pharmacology approaches to express the plasma effect concentrations as exposures of the drugs as disinfectants. A similar approach was used for measured and predicted river concentrations of NSAIDs, which were used to predict plasma concentrations of NSAIDs in wild fish. The overlay of the two approaches led to a visual model that enabled a rapid assessment of the risk posed by environmental levels of NSAIDs to trigger multi-scale adverse effects. The major strength of the model is the ability it has to predict the potential of NSAIDs mixtures, expressed as diclofenac-equivalents. We propose that this mechanistic approach may provide a useful predictive tool to support the implementation of effective NSAIDs ecochronopharmacovigilance strategies and facilitate the regulatory interpretation of past and future toxicity data.

**WE009 Evolution in the lab - How can we study the chronic exposure to pharmaceuticals over multiple generations?**

K. Heye, Goethe University Frankfurt/ Main / Aquatic Toxicology; A. Schmidt, Goethe University Frankfurt / Aquatic Ecotoxicology; J. Oehlimann, Johann Wolfgang Goethe-Universität Frankfurt / Aquatic Ecotoxicology

Larval exposure of non-target organisms is only covered in the assessment of chemicals. Especially pharmaceuticals play an important role when it comes to long-term exposure. They enter the environment throughout the year and therefore pose a continuous risk to organisms. One of these ubiquitously detected pharmaceuticals is the antiepileptic drug carbamazepine (CBZ). Hardly degraded during conventional wastewater treatment, it contaminates a majority of wastewater streams. CBZ and its metabolites can act as biocides, but are also potentially toxic to other pharmaceuticals like CBZ? To answer this question, the non-biting midge Chironomus riparius was chosen as a test organism for a multi-generation experiment. 2400 chironomid larvae (24 h old) were taken from a laboratory culture to set up two exposure cages – one where larvae were continuously exposed to the LC50 of CBZ (0.4 mg/L, nominal concentration) and one control. When we were sure that a new generation had started, egg clutches were taken out of the cages to set up two chronic toxicity tests. Lethal and effect concentrations of mortality and mean time to emergence were calculated using a non-linear regression model (logistic curve). Sensitivity was compared by looking at overlaps of the 95% confidence intervals (CI). Two months after the beginning of the experiment, mortality seemed to be lower in the pre-exposed group compared to the control. However, CI of the LC50 still overlapped (0.506 ± 0.882 mg/L for the control and 0.729 ± 1.1 mg/L for the pre-exposed group). Four months later, sensitivity was compared again. LC50 of the pre-exposed group was higher than in the control, with no overlap of the CI (0.668 ± 1.02 mg/L for the control and 1.08 ± 1.96 mg/L for the pre-exposed group). After two and six months, control mortality of both groups was low and emergence in the cages stayed constant. Multi-generation experiments are a helpful tool to investigate long-term effects of chemicals on aquatic organisms. Within the first six months of the ongoing study, midges showed to be less sensitive to carbamazepine after long-term low-level exposure. Chronic toxicity tests to study the authors of exposure groups should be combined with genome and transcriptome analyses to get a full picture of adaptation processes in midges. Acknowledgement - The authors thank the Federal Ministry of Education and Research (BMBF) for funding (NiddaMan, project support contract 02WRRM1367A).

**WE010 Effects of duloxetine and econazole on freshwater species towards individual and combined conditions**

G. AMARIEJ, Universidad de Alcala; K. Boltes, University of Alcala / Chemical Engineering; J. Valimaña-Traverso, M. García, P. Letón, M. Marina, R. Rosal, University of Alcala

A thousand of biologically active pharmaceuticals (APIs) are used in human and veterinary medicine worldwide. Nowadays, the occurrence of pharmaceuticals in aquatic environments is a well-established issue, there are still gaps in our knowledge on the fate and effects of these compounds in the environment. Evaluating API ecotoxicology is even more challenging due to uncertainties about appropriate dosages, durations of exposure, range of sensitive taxa, sensitivity of developmental stages, and toxicological endpoints. More attention should be paid on the non-target organisms and the chiral nature of contaminants. This work assess the toxicity of the antidepressant drug Duloxetine and the antifungal Econazole, individually and combined, on three freshwater species—algae, crustacean and duckweed, using APIs concentration from 0.039 to 100 mg L−1. Level an type of drugs interactions were determined using the Combination Index-isoobologram method. The enantiomers concentration of the target compounds in the culture media were (R)- and (S)- APIs. Combining the concentration between degradation profile and the observed toxicity on organisms. Results reveal toxic effects of Duloxetine and Econazole leading to growth reduction and significant changes in the morphology of duckweed fronds. The EC50 values obtained showed Duloxetine as very toxic for algae and toxic for crustacean and plants. Econazole appears as very toxic for all species evaluated. Mixed toxicity indices (rOBIs) for the target APIs (TCAs) are now on market worldwide. It is possible to measure the concentrations of selected antidepressants by chemical analysis, but such concentrations do not indicate the physiological activity of antidepressants in waters. For example, even if the concentration of each substance is low, through additivity compounds might produce a strong enough physiological activity to harm aquatic organisms. To determine whether antidepressants in aquatic environments cause similar effects to those observed in humans, we must know the extent to which such organisms may be exposed to antidepressants as determined by the inhibition of monoamine transporters. In this study, we measured the physiological activity of antidepressants in WWTP effluents for the first time by the in vitro assay (namely called antidepressant assay). We utilized fluorescence substrate, APP, for monoamine transporters (serotonin transporters (SERT), norepinephrine transporter (NET), and dopamine transporter (DAT)). By transfecting a plasmid expressing transporter into cultured cell line, and measuring the fluorescence intensity inside the transfected cells, inhibitory activity of antidepressant on the uptake of APP by transporter could be quantified. We applied the antidepressant assay to secondary effluents (SEs) of WWTPs in Japan, and used a protocol to detect the inhibitory activity of antidepressants in SEs. Inhibition was detected in SERT or NET-expressing cells, but not in DAT-expressing cells, suggesting that detected inhibitory activity come from SSRIs, SNRLs, and/or TCAs, not DRIs in SEs. Activities detected in SEs could be quantified as antidepressant-equivalent quantities (EQs). By comparing EQ values with the effective concentrations of antidepressants in vivo behavior testing, we can know whether antidepressants in environmental water is really risky to aquatic organisms.

**WE012 Toxicology of pharmaceuticals to aquatic organisms: a meta-analysis of effects on development and reproduction**

V. F. Fonseca, I.A. Duarte, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCL; B.M. Gillanders, School of Biological Sciences, The University of Adelaide / Southern Seas Ecology Laboratories; P. Reis-Santos, MARE - Marine and Environmental Sciences Centre

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The ubiquity of pharmaceutical compounds in the aquatic environment, their growing use and their potential to elicit biological effects even at low concentrations is a major concern to environmental health and safety management. In recent years an increasing number of studies have addressed the presence and toxicity of various pharmaceuticals, using various biological endpoints in different biological models, and reporting varying effects. Accordingly, a systematic question under assessment is key to improve current understanding of the ecological risks of pharmaceuticals at non-target levels in the aquatic environment. To unravel patterns in biological responses across aquatic taxa a meta-analysis was performed on reported effects of exposure to pharmaceutical compounds (according to therapeutic class). Minimum response concentration and biological responses were collected from selected studies based on a set of criteria considering organisms’ exposure to pharmaceuticals under controlled conditions. For a response sensitivity analysis various endpoints were considered namely biochemical, developmental (e.g. growth), reproductive and behavioral responses, as well as lethality, in studies reporting effects on aquatic taxa. The comparative sensitivity analysis of biological endpoints highlighted the sensitivity of molecular responses, followed by individual level-responses (e.g. behavior and growth), yet variable sensitivity across among taxa were observed when considering different pharmaceutical classes. Data availability and comparability limited quantitative analysis, yet the meta-analysis provided a key framework to compare effects influence on development and reproduction of crustacean and fish exposed to pharmaceuticals. Overall the implications of current findings for environmental monitoring and ecological risks of pharmaceuticals in aquatic ecosystems are discussed.

**WE013**  
Leveraging Pharmacological Data for Prioritization of the Ecological Risks of Chiral Pharmaceuticals  
E. Ungayay-Vasquez, Shantou University / Marine Biology Institute; J. Gan, University of California, Riverside / Department of Environmental Sciences  
Pharmaceuticals are frequently detected in wastewater and the environment at concentrations ranging from ng/L to µg/L. More than 50 % pharmaceuticals are chiral compounds. Enantiomers of chiral pharmaceuticals have been shown to exhibit differences in environmental fate, transport and toxicity. Since more than 2,500 pharmaceuticals are currently in use, it is infeasible to carry out whole organism toxicity studies of all pharmaceuticals. However, there is a wealth of knowledge available from drug discovery and development research that can be leveraged for predicting potential environmental exposure and effects of chiral pharmaceuticals. Assuming evolutionary conservation of primary drug targets, read-across can be used to predict the potential effect of chiral pharmaceuticals. In this study, we estimated the stereoselective effect of 11 chiral pharmaceuticals using the fish plasma model. We found metoprolol had high risk with an effect ratio, ER (ratio of human therapeutic plasma concentration to fish plasma concentration at steady state) that was less than 1.0, whereas propanolol, salbutamol, fluoxetine and venlafaxine were medium risk (1.0 < ER < 30). However, stereoselectivity was predicted in all compounds except atenolol and pindolol. In this study, we showed the fish plasma model has considerable potential for predicting stereoselective toxicity of chiral pharmaceuticals.

**WE014**  
Effects of benzoylcoenzyme exposure at different levels of the biological hierarchy on Daphnia magna  
M. Parolini, University of Milan / Department of Environmental Science and Policy; B. De Felice, Università degli Studi di Milano; C. Ferrario, University of Milano Bicocca; N. Salgueiro, University of Ontario Institute of Technology; E. Ussery, University of Ontario Institute of Technology / Science  
Benzoylcoenzyme (BE) is a metabolite of cocaine, is the main illicit drug residue measured in aquatic ecosystems. For a response sensitivity analysis various endpoints were considered namely biochemical, developmental (e.g. growth), reproductive and behavioral responses, as well as lethality, in studies reporting effects on aquatic taxa. The comparative sensitivity analysis of biological endpoints highlighted the sensitivity of molecular responses, followed by individual level-responses (e.g. behavior and growth), yet variable sensitivity across among taxa were observed when considering different pharmaceutical classes. Data availability and comparability limited quantitative analysis, yet the meta-analysis provided a key framework to compare effects influence on development and reproduction of crustacean and fish exposed to pharmaceuticals. Overall the implications of current findings for environmental monitoring and ecological risks of pharmaceuticals in aquatic ecosystems are discussed.

**WE015**  
Impact of the antidiabetic drug metformin and its transformation product guanylurea on brown trout (Salmo trutta f. fario)  
S. Jacob, Universität Tübingen / Animal Physiological Ecology; L. Kundt, M. Biecker, University of Tübingen; R. Trimboskorn, University of Tübingen / Animal Physiological Ecology  
The last decades, the number of patients suffering from diabetes type 2 is increasing. Consequently, a rising consumption of antidiabetic drugs as metformin (MF) has become obvious. In wastewater treatment plants, metformin is only partially retained and also transformed to guanylurea (GU) leading to high concentrations of both compounds in surface waters. However, possible effects of MF and GU in aquatic organisms are far from being understood. The aim of this study is therefore to investigate influences of MF and GU on different metabolic pathways and behaviour in different life stages of brown trout (Salmo trutta f. fario). Juvenile trout (age: 8 month) were exposed for 4 weeks at 7°C to different concentrations of MF (0, 10, 1000 µg/L) and GU (0, 10, 100, 1000 µg/L). Additionally, eggs of brown trout in the eyed ova stage were exposed to different metformin concentrations (0, 1, 10, 1000 µg/L) at 7°C & 11°C (regarding possible interactions of chemical toxicity & temperature). To show influences on the embryo development, mortality, hatching rate, and heart rate were recorded. Tissue samples were taken three and eight weeks after the end of the sac-fry stage. In all experiments, several endpoints characterizing fish health were investigated, including the histological condition of the liver, alterations in the stress protein level (Hsp70), changes in the intestinal microbiome and additionally the glycogen storage in the liver of MF-exposed fish. Besides, swimming and predator-prey behaviour were investigated. There was no influence of MF on the developmental parameters in brown trout larvae. Neither behaviour nor stress protein level were influenced by MF. The liver tissue of the MF-exposed trout was in a good condition. The glycogen storage was tendentially increasing in MF-exposed fish compared to the control, whereas the glycogen content of the trout exposed to 1000 µg/L MF was partially decreased. The intestinal microbiome of MF-exposed larvae showed a significantly different composition compared to the control. The results for the experiment with GU will be presented (analyses not yet finished). This work is part of the project Eff-Net (Effect Network in Water Research) funded by the European network Baden Württemberg. By a multi-organism exposure to environmentally relevant concentrations of MF and GU, it will be investigated in an ecotoxicological approach how MF and GU influence the survival, growth, and life quality of fish with an emphasis on yearling fish.

**WE016**  
Effect of life-cycle exposure to environmentally relevant concentrations of metformin and its metabolite guanylurea on F1 progeny 28 days post hatch.  
Z.P. Pandelidis, University of Ontario Institute of Technology; E. Ussery, University of Ontario Institute of Technology / Biological Sciences; J. Guchardi, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Science  
Recent studies have demonstrated that the type 2 diabetic drug metformin and its only known metabolite, guanylurea, are common environmental contaminants found in the ng-µg/L concentration range in surface waters and wastewater effluent. This should be of concern as recent work in our lab shows that Japanese medaka (Oryzias latipes) exposed to environmentally relevant concentrations of metformin and guanylurea from embryo through 28 days post-hatch have a significant decrease in length and weight of both males and females when compared to control fish. Furthermore, our studies show that larvae exposed for 28 days to both compounds have a significant dysregulation in lipid and fatty acid metabolism, possibly leading to this stunted growth. A full life-cycle exposure to both compounds at environmentally relevant concentrations, alone and in combination, was investigated in order to examine the effects of chronic exposure to the F1 progeny. The effects of metformin and guanylurea on the length and wet weight were compared 28 days post hatch and will be discussed. Possible implications of exposure to metabolomics and gene expression will be explored.

**WE017**  
Life-cycle effects in Oryzias latipes exposed to environmentally relevant concentrations of metformin and its metabolite, guanylurea.  
E. Ussery, University of Ontario Institute of Technology / Biological Sciences; Z.P. Pandelidis, University of Ontario Institute of Technology / J. Guchardi, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Science  
O. stornorini One of the most common environmental contaminants in the aquatic environment is the type 2 diabetic drug metformin. Metformin has been measured in the ng-µg/L concentration range in both German and North American surface waters and wastewater effluent. As the majority (>90%) of metformin is metabolized into...
guanyleurine during the waste water treatment process, it is found in the environment in higher concentrations than metformin, usually in the μg/L concentration range in surface waters. This is concerning, as our recent research shows that Japanese medaka (Oryzias latipes) exposed to environmentally relevant concentrations of metformin (1.0-100 μg/L) and guanyleurine (1.0-100 ng/L) from embryo through 28 days post hatch have a significant decrease in length (mm) and weight (mg) of both male and female fish when compared to control fish, with guanyleurine appearing to be roughly 1,000 times more potent than metformin. Furthermore, these studies show significant changes in the metabolism of 28 day old male medaka exposed to both metformin and guanyleurine, indicating significant dysregulation in fatty acid and lipid metabolism. These results raised concern regarding the consequences of a full life cycle exposure, including the important reproductive phase. Thus, a full life-cycle continuous exposure experiment was undertaken utilizing both compounds at environmentally relevant concentrations, alone and in combination, was conducted in order to examine the effects of chronic exposure on growth, reproduction, steroid production, and gene expression. Results will be discussed.

**WE018 Environmental Fate and Effects of the Antidiabetic Drug Metformin and Its Transformation Product Guanyleurine**

J. Straub, F.Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental Protection; D.J. Caldwell, Johnson & Johnson / Environmental Health Safety Sustainability; V. D’Aco, Quantum Management Group, Inc.; T. Davidson, BladeChem; M. Espig, Bayer Life Science; A. Ghilardi, Merck KGaA; J.G. Tull, Merck & Company, Inc. / Global Safety the Environment

Metformin (MET) is an active pharmaceutical ingredient (API) with very high patient use worldwide that is excreted in unchanged form. This has led to concern about the potential aquatic life impacts associated with the presence of MET in surface waters. Several analyses of aquatic organisms have identified MET (and guanyleurine) as major contaminants in fish and crustaceans. In addition, MET has been identified in the high ng/L to low µg/L range in wastewater streams, where it is known to be transformed to guanyleurine (GUU) through a variety of processes. Therefore, the potential aquatic life risk assessment of MET and GUU in surface water is presented that is about the potential aquatic life impacts associated with the presence of MET in aquatic ecosystems, whereby it has been detected in the high ng/L to low µg/L range in wastewater streams. This is concerning, as our recent research shows that Japanese medaka (Oryzias latipes) exposed to both metformin and guanyleurine, indicating significant dysregulation in fatty acid and lipid metabolism. These results raised concern regarding the consequences of a full life cycle exposure, including the important reproductive phase. Thus, a full life-cycle continuous exposure experiment was undertaken utilizing both compounds at environmentally relevant concentrations, alone and in combination, was conducted in order to examine the effects of chronic exposure on growth, reproduction, steroid production, and gene expression. Results will be discussed.

**WE019 Fluoxetine exposure modulated antioxidant and anxiety-related gene expression altering swimming activity in zebrafish embryos**

B. De Felice, Università degli Studi di Milano; A. Ghilardi, L. Del Giacco, University of Milan; M. Marolin, University of Milan / Department of Environmental Science and Policy

The massive release of human pharmaceuticals into the aquatic ecosystems continues to be a serious environmental problem. Among pharmaceuticals, psychotropic drugs such as antidepressants are one of the main therapeutic classes detected in freshwater worldwide. Selective serotonin reuptake inhibitors (SSRIs) are commonly the first-line antidepressant drugs prescribed to alleviate anxiety disorders in humans, and fluoxetine (FLX), the active principle of the Prozac®, is one of the most frequently prescribed worldwide. All FLX enters the aquatic ecosystems, whereby it has been detected in the high ng/L to low µg/L concentration range. Although many studies have demonstrated that the exposure to FLX caused a plethora of adverse effects in aquatic species, the information regarding its molecular mechanisms of action and the relationship with organism behavior remains scant. Thus, the present study was aimed at investigating 1) the effects induced by FLX and its transformation products (TR, 500 ng/L) in the expression of genes related to oxidative stress response (sod1, sod2, cat, gpx, gst), stress and anxiety (ox1, ptl2, nyp and ucn3), as well as transporters of main neurotransmitters (scl6a3, scl6a4a, scl6a4b, scl6a11) and 2) if changes in the expression of neurotoxicity-related genes was related to changes in the swimming behavior of zebrafish (Danio rerio) embryos at 96 hours post fertilization (hpf). Our results showed that FLX exposure overexpressed sod1, cat and gpx, suggesting that this drug can induce an overproduction of pro-oxidant molecules. In addition, changes in the expression of scl6a4a, scl6a4b, scl6a11 genes indicated that FLX can affect neurotransmission and, consequently, alter swimming behavior of embryos, as demonstrated by the significant reduction of the distance moved by treated embryos in response to an external stimulus.
After use, pharmaceuticals and their residues eventually end up in the sewage system. Sewage treatment plants reduce the nutrient load of waste water, and while organic micropollutant removal occurs concomitantly by bacterial activity and sorption onto many contaminants, including pharmaceuticals, some are not completely removed. Consequently, effluent containing pharmaceuticals and their residues is discharged into surface waters. A recent study showed that 29 of 80 monitored pharmaceuticals were regularly detected in Dutch surface water, and that five of these substances, i.e. the pain killer diclofenac, the antibiotics azithromycin, clarithromycin and sulfamethoxazole, pose a risk to the aquatic ecosystem (Moermond et al., 2016). This raises concern, perhaps even more so when considering that for many of the around 2000 pharmaceuticals that were authorized for the Dutch market in 2016, it remains unknown to what extent they are present in surface waters, how they behave in the environment, and to what extent they exert toxicity to aquatic species individually and jointly. A class of pharmaceuticals that has received increased attention in the Netherlands, but also in the EU, e.g. PHARMAS project and Cytothreat, are cytostatics. These potent substances are used to inhibit cell division in cancer patients, but the fraction released unchanged to surface water could affect aquatic species in a similar manner. This project aimed to provide an overview of the use of cytostatics in the Netherlands and to determine if cytostatics pose a potential risk to the aquatic ecosystem. For an inventory was made of cytostatics and their occurrence into surface waters. A top 10 of cytostatics was compiled by taking into account the metabolic transformation of cytostatics in patients, the removal efficiency in sewage treatment plants, and the available monitoring data in Dutch surface waters. For these 10 cytostatics, available environmental fate and effect data were gathered and set in relation to environmental concentrations were derived. Comparison to predicted and measured environmental concentrations will allow to conclude if the selected cytostatics pose a potential risk to the aquatic environment.

**WE023 Environmental risk assessment of human pharmaceuticals - what can we learn from regulatory effect data so far?**

S. Schwarz, German Environment Agency / UBA / Section IV 2.2

Pharmaceuticals; J. Bachmann, German Environment Agency (UBA) / Section IV 2.2

Environmental Risk Assessment of Pharmaceuticals; U. Brandt, German Environment Agency UBA / Section IV 2 Environmental Risk Assessment of Pharmaceuticals

Since the coming into force of the guideline on the environmental risk assessment of medicinal products for human use (EMEA/CHMP/SWP/4447/00 corr 2), the German Environment Agency (UBA) is tasked with environmental risk assessment of human pharmaceuticals. Applicants seeking approval of medicinal products need to submit fate and effect data, in case predicted environmental concentrations exceed 10 ng/L in surface waters, or the substance is of specific concern through its mode of action. For an inventory was made of cytostatics and their occurrence into surface waters. A top 10 of cytostatics was compiled by taking into account the metabolic transformation of cytostatics in patients, the removal efficiency in sewage treatment plants, and the available monitoring data in Dutch surface waters. For these 10 cytostatics, available environmental fate and effect data were gathered and set in relation to environmental concentrations were derived. Comparison to predicted and measured environmental concentrations will allow to conclude if the selected cytostatics pose a potential risk to the aquatic environment.

**WE025 SETAC Pharmaceuticals Interest Group**

G. Maack, German Environment Agency / Ecotoxicological Assessment

**WE026 What makes a chemical substance a ‘natural substance’? A case study in the context of the EU veterinary medicines marketing authorisation procedure**

T. Hahn, Fraunhofer Institute Toxicology and Experimental Medicine / Chemical Risk Assessment; C. Flesher, HAW Hamburg / Department of Environmental Engineering; S. Schwonbeck, G. Koennecker, Fraunhofer Institute Toxicology and Experimental Medicine / Chemical Risk Assessment

The marketing authorisation process for veterinary pharmaceuticals in the EU and other countries requires an environmental impact assessment (EIA) for each veterinary medicinal product (VMP). This EIA follows a phased approach with conservative estimates of environmental exposure in phase I, which may later require refinement by experimental data in phase II. Core of the phase I assessment is a catalogue of 19 questions on use and characteristics of the VMP under consultation. These questions aim at establishing an initial predicted environmental concentration, which, together with information on therapeutic use and targeted animal species, allows for the necessity of performing an in-depth phase II assessment. According to question 2 in the phase I assessment a substance is exempted from further investigation when there is scientific proof that it is a natural substance “the use of which will not alter the concentration or distribution in the environment”. At first sight this definition appears unambiguous. Nevertheless may it be a hurdle for applicants because no further guidance is given which criteria apply for acceptance or rejection of a given concentration as ‘natural’. Here, we present a case study comprising two substances in order to highlight possible uncertainties for applicant companies, as well as for competent authorities.

**Obesogens and lipid disruptors (P)**

**WE027 Unraveling distinct pathways of PFOS toxicity by combining morphological, metabolomic and transcriptomic analyses**

R. López, Institute of Environmental Assessment and Water Research (IDAEA-CSIC) / Environmental Toxicology; L. Navarro-Martín, C. Luccarelli, IDAEA-CSIC; E. Ortiz, IDAEA-CSIC / Department of Environmental Chemistry; A.E. Codina, CNAG; D. Roldua, IDAEA-CSIC; C. Barata, CSIC / Environmental Chemistry; B. Pina, IDAEA-CSIC / Department of Environmental Chemistry; R. Tauler, IDAEA-CSIC / Environmental Chemistry

Exposure to PFOS (perfluorooctylsulfonate) has been related to toxic effects on lipid metabolism, immunological response, and different endocrine systems. We present here a combined metabolomic and transcriptomic analysis of zebrafish embryos exposed to different concentrations of PFOS (30-1000 ppb) from 48 to 120 hpf. While parallel morphological analysis showed no macroscopic changes below the 1000 ppb mark, some metabolomic and transcriptomic changes occurred even at the lowest concentration. Functional analysis of the observed changes revealed at least three major modes of action: alteration of PPAR signalling and lipid metabolism, effects on cell-cell interaction, perhaps linked to effects on the immune response and neuronal system development, and a general alteration of the development, reflected by an alteration of different development- and metabolism-related signalling pathways, likely affecting to cell cycle functions, and
to the metabolism of proteins, nucleotides, and amino acids. The results suggest a complex, multiple endocrine disruption-like toxic effects, at a concentrations well below the 1 ppm considered the LOAEC/NOAEC for many of the macroscopic effects traditionally linked to PFOS toxicity in zebrafish embryos, including lipid disruption, effects to sensorial organs, and lethality. It is also remarkable the functional correlation between these macroscopic effects and the molecular changes we observed at metabolic and/or transcriptomic levels at concentrations 10 to 100 below the macroscopic NOAEL.

WE028 Impacts of fatty acids and methylmercury on preadipocyte differentiation in rainbow trout (Oncorhynchus mykiss).

G. Neves, University of Louvain / Université de Louvain / Institut des Sciences de la Vie; J. Rees, University of Louvain / Université de Louvain / Institut des Sciences de la Vie.

Fish can be exposed to nutritional and chemical stress. In aquaculture, fish oil is increasingly replaced by plant-derived oils, which results in a modification of the fatty acid (FA) composition of the diet. Also, pollutants such as methylmercury (MeHg) are still present in aquatic environments. Adipose tissue is an essential endocrine organ involved in energy homeostasis and can be affected by some stressors. However, there is a lack of knowledge about the effects of FA and MeHg on rainbow trout adipose tissue. In this context, in vitro experiments were carried out on trout primary cultured adipocytes to study the effects of FA and those of MeHg. Effects of FA - During 2 days, differentiation of confluent cells was induced through a hormonal cocktail. Cells were then incubated during 13 days with 0, 75, 150, 300 and 600 µM of α-linolenic (ALA), eicosapentaenoic, docosahexaenoic (DHA), LA, arachidonic and docosapentaenoic (DPA) acids and 2 and 5 nM of FA. The lipid mixtures at day 13 for each FA, the higher the concentration, the more the lipid accumulation. At 600 nM, DHA and DPA were the most adipogenic FA, while LA and ALA (typical to plant-derived oils) induced less lipid accumulation. For all conditions, a clear enrichment of membranes and lipid droplets with the incubated FA was observed. Effects of MeHg - Confluent cells were incubated for 6 days with or without a hormonal cocktail, with 0.5, 2.5 or 5 mM MeHg and with 4 µLM lipid mixture. No cytotoxicity was observed. At day 6, cells were collected to determine mercury concentration, FA content and composition, and gene expression. Analyses are in progress. Preliminary results showed that the hormonal cocktail combined to increasing MeHg concentrations tended to affect cell morphology, towards a more typical adipocyte phenotype. In contrast, FA incorporation of FAs can be different at organism and cell levels. Regarding the effects of MeHg, we can highlight the presence of cells with typical adipocyte morphology in presence of hormonal cocktail and MeHg. For both experiments, analyses of expression of genes related to adipocyte differentiation, lipid metabolism and lipolysis are under progress and could provide helpful results to understand better the impacts of stressors in trout preadipocytes.

WE029 Obesogens in the aquatic environment

A. Capitão, CIMAR; University of Porto; A. Lyssimachou, CIMAR; E. Castro, CIMAR - University of Porto; M.M. Santos, CIMAR/FCUP / Biology/Endocrine Disrupters and Emerging Contaminants.

The rise of obesity in humans is a major health concern of our times, affecting a increasing proportion of the population worldwide. It is now evident that this phenomenon is not only associated with the lack of exercise and a balanced diet, but also due to environmental factors, such as exposure to environmental chemicals that interfere with lipid homeostasis. These chemicals, also known as obesogens, are present in a wide range of products of our daily life, such as cosmetics, paints, plastics, food cans and pesticide-treated food, among others. A growing body of evidences indicates that their action is not limited to mammals. Obesogens also end up in the aquatic environment, potentially affecting its ecosystems. In fact, reports show that some environmental chemicals are able to alter lipid homeostasis, impacting weight, lipid profile, signaling pathways and/or protein activity, of several other aquatic organisms. Such a priority issue in aquatic toxicology. One of the most prevalent pharmaceutical contaminants is the type-2 diabetic drug metformin, which has been found in wide-ranging concentrations (ng/L - µg/L) in wastewater effluent and surface waters. Greater than 90% of metformin is metabolized into guanylurea during wastewater treatment, and it’s the metabolite guanylurea that is found in receiving waters in relatively high concentrations (µg/L). To improve our understanding of the toxicological effects of metformin and its metabolites, we adapted a mammalian cell line to human adipose or bone cell lineages. Future research using MSCs cells as model for adipogenesis will not only look at the differentiation to white adipocytes. We also envisage to employ the model to gain an understanding of other processes such as the more recently described “browning” of white adipocytes and the differentiation of MSCs to brown adipocytes.

WE031 Comparing metabolomic responses in Oryzias latipes to environmentally relevant concentrations of metformin and its metabolite, guanylurea

F. Eussey, University of Ontario Institute of Technology / Biological Sciences; K. Bridges, B.J. Venables, University of North Texas / Advanced Environmental Research Institute; Z.P. Pandelides, University of Ontario Institute of Technology; J. Guichard, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; A. Kirkwood, University of Ontario Institute of Technology; D.A. Holdway, University of Ontario Inst. of Tech / Science.

In recent years, the occurrence and fate of pharmaceuticals in the aquatic environment has become of concern. Pharmaceutical compounds and their metabolites, such as metformin and its metabolite guanylurea, are excreted in large quantities by diabetics and are found in aquatic environments. In this study, we measured the effects of metformin and guanylurea on the fish Oryzias latipes to environmentally relevant concentrations. Male medaka were exposed to an extremely low concentration of guanylurea (1.0 ng/L), there was a similar percent decrease in length (~22%; mm) and wet weight (~22%; mg) of male Japanese medaka (Oryzias latipes) when exposed to 3.2 µg/L metformin from embryo through 28 days post hatch. Using radio labeled metformin, we demonstrated that about 1% of the waterborne concentration of metformin could be taken up in both embryo and larval medaka after exposure windows ranging from 24 hours to 7 days. We also conducted a metabolomics assessment of metformin and guanylurea exposed fish to elucidate the sub-lethal biochemical mode of action for each contaminant exposure. Significant changes were detected in the metabolome of 28-day larval male medaka exposed to both metformin and guanylurea, indicating significant dysregulation in fatty acid and lipid metabolism. This biochemical effect is likely a contributing factor to the observed decreased growth in exposed fish. In combination, these results suggest that the current concentrations of metformin and guanylurea in receiving waters are of ecotoxicological concern for resident fish populations.

WE032 Levels of proteins, carbohydrates, lipids and cholesterol in the digestive gland of juvenile catarina clam Argopeyetoc ventricosus (Sowerby, 1842), exposed to toxic metals

A. Serrano-Figueras, Universidad Autónoma Metropolitana Iztapalapa / Instituto de Biología; C. Cárdenas, Universidad Autónoma Metropolitana Iztapalapa / Instituto de Biología; C. Cortés, Universidad de California Sur

The analysis of the composition of the digestive gland, gives information on the energy level of the organism, this energy is mobilized in the different stages of its life cycle. When the organisms are subjected to severe stress conditions, it has been observed the mobilization of these reserves to maintain homeostasis, in short periods of time. In this work, an evaluation of the composition of the digestive gland of juvenile catarina clam exposed to the metals Cd, Cr, Pb and their mixtures was carried out to determine their energy content. Bioassays with water replacements were carried out. The organisms were exposed to 1 sublethal concentration of each metal (LC50): 0.35, 5.0 and 3.0 mg L−1 of Cd, Cr and Pb
respectively) and of the mixtures in proportion 1:1. The levels of proteins (Lowry, 1951), carbohydrates (Dubois, 1956), lipids (Bligh and Dyer, 1959) and cholesterol (Kit Biorad) were quantified at 24, 96, 144 and 168 hours after the start of the bioassay. The Kruskal-Wallis test showed that the difference between the concentrations of proteins, lipids, cholesterol and carbohydrates of the control group compared to the treatments was significant (p < 0.034). An increase in cholesterol levels was observed at 24 hours of exposure and a decrease for lipids, protein and carbohydrate levels of up to 75% in only 96 hours (4 days) of exposure to metals and their mixtures. This indicates that juveniles exposed to metals had high stress levels, (as was also observed in relation O:N). It should be mentioned that the surviving organisms of the tests, died 48 hours (2 days) after it was observed the mobilization of their energy reserves.

Environmental risk assessment and management of the spoil material produced in tunnelling excavation (P)

EW033 Environmental assessment of foaming agent persistence in conditioned soil for EPB-TBM tunnelling


Earth Pressure Balanced Shields are currently the most used full face tunnelling machine thanks to the wide use of conditioning agents in different soil types that change the mechanical and hydraulic behaviour of the soil into a plastic paste, permitting soil pressure applications in the bulk chamber. The most frequently conditioning agents used for soil in the bulk chamber are various types of foams that are mixed to the soil from injection points located on the cutter head and inside the bulk chamber to give the conditioned soil properties necessary to guarantee that the EPB machine will work in the proper way. The excavation process produces a large amount of spoil material rich in foaming agents that can have an impact on ecosystems. The possible way-of-reuse of the excavation products strongly depend on the additive composition, on soil properties and environmental conditions. Currently, there are no threshold limits in European legislation for these components or comprehensive studies on their environmental risk and persistence for soil ecosystems in these exposure scenarios. In this context, the objective of this study was to evaluate the biodegradability of the sodium lauryl ether sulphate (SLES) contained as the main component of two commercial foaming agents in two different soils (S1: silty-clay; S2: gravel in a clay-silty-sand matrix soils) sampled from a construction site. Moreover, the degradability of one product was evaluated in the presence of an additive used to improve the compaction and subsequently transport of the spoil material. For this purpose, microcosms were set up using soil samples conditioned separately with the two foaming agents. Control microcosms, consisting of untreated soil, were also set-up to compare the microbial community before and after the foaming agent addition. At selected times, soil samples were collected for assessing SLES concentration by AEX extraction followed by MBAS spectrophotometric method. Microbiological analyses were performed in order to assess microbial abundance, viability and dehydrogenase activity in the conditioned and control soils. Results showed that SLES degradation depended on the soil type, with DT50 ranging from 11 to 19 days; the additive increased significantly the surfactant persistence especially in the S2 soil. In the latter case, the higher persistence of the product can be ascribed to the detrimental effect of the additive on the microbial abundance and activity.

EW034 Application of the Vibrio fischeri acute toxicity test to assess the environmental impact of spoil materials containing foaming agents


The rapid development of TBMs in the tunnelling industry has been mainly due to the improvement in their tunnelling speed. The performance of TBMs relies on the use of appropriate soil conditioning foaming agents containing water solutions of anionic surfactants, mainly sodium lauryl ether sulphate (SLES) and in smaller concentrations other additives. In accordance with the Italian legislation, spoil material from excavation processes can be re-used as by-products if the chemical thresholds for organic and inorganic contaminants (e.g. heavy metals, hydrocarbons C<12; Italian Decrete 120/2017) are not exceeded. However, there are currently neither SLES soil thresholds nor thresholds for anionic surfactant in soil and water legislation. The use of ecotoxicological tests makes it possible to overcome the analytical limits to detect multicomponent commercial foaming products (of which the complete composition is often unknown), to save time by avoiding the designing of new analytical methods for the increasing number of chemicals used in new foaming formulations continuously being put on the market. Above all, they provide information about the different interactions between the mixture and the specific matrix and the possible ecotoxicological effects on biota. In several studies performed to evaluate the potential impact of spoil materials on the bacterium Vibrio fischeri showed it to be very sensitive to the residual concentrations of the surfactant SLES in eluates obtained from soil samples collected from excavation sites. The overall analysis of a set of chemical and ecotoxicological data showed that the bioluminescence inhibition was directly related to SLES concentration. Consequently, the ISO 11348-3:2007 test is a suitable tool to assess in a short time the occurrence of foaming agent residuals at effect concentrations in spoil material.

Biodegradability of the anionic surfactant sodium lauryl ether sulphate used as the main component in two foaming agents for tunnelling process


The anionic surfactant sodium lauryl ether sulphate (SLES) is the main component of most commercial products used for soil conditioning in the excavation industry, in particular as lubricants for mechanized tunnelling. This excavation process produces a large amount of spoil materials that can have a potential impact on ecosystems. The lack of accurate information about SLES persistence in the environment has aroused increasing concern for their possible recycling as construction materials or as soil replacement for covering rocky areas. Currently, there are neither SLES soil threshold limits in European legislation, nor comprehensive studies on the environmental risk for soil ecosystems in these exposure scenarios. The objective of this study was to evaluate the biodegradability of the sodium lauryl ether sulphate (SLES) contained in two common commercial foaming agents (P1, P2). For this purpose, a set of microcosms was set up using two different soils (S1: silty-clay soil; S2: gravel in a clay-silty-sand matrix soil) from the construction site. Microcosm experiments were set-up with soil samples conditioned separately with foaming agent P1 (SLES concentration 120 mg/kg) or P2 (83 mg/kg SLES concentration). Some soil samples were previously sterilized in order to evaluate abiotic degradation in absence of the microbial community. Moreover, control microcosms, consisting of untreated soil, were also present in order to compare the microbial community before and after the foaming agent addition. At selected times (0, 7, 14, 21, 28 days) soil samples were collected from microcosms. SLES concentrations in extracts were determined spectrophotometrically. Cell viability (Live/Dead method), dehydrogenase activity and the phylogenetic structure of the microbial community were assessed by the Fluorescent In Situ Hybridization (FISH) method. Although an initial negative effect on microbial abundance and viability was observed, at the end of the experiment SLES was no longer detected in all soils regardless of soil type and cellular vitality was comparable between treated and control soil. SLES was completely biodegraded at day 28 and a shift in the microbial community was observed comparing the control vs treated soils. In particular, a significant increase in the Gamma-Proteobacteria group, which includes bacteria able to transform SLES, has been found.

Development of new foaming agents with better environmental impact for EPB soil conditioning - The Polyfoamer ECO line

A. basilico, e. dal negro, Mapei SpA / Underground Technology Team; m. stefanoni, Mapei SpA / R&D

New foaming agents with better environmental impact: the POLYFOAMER ECO line Thanks to the development of new foaming agents carried out by the R&D Group, MAPEI have created the new product line Polyfoamer ECO, with the main goal to reduce the environmental impact on the tunnel muck, thus facilitating the re-use of the tunnel muck as-by-products, in example for road constructions or old quarries refilling. All the new Polyfoamer ECO foam agents have been conditioned by a third-party test laboratory as Wettability and cell viability tests. Thanks to the new low-cost of risk agents waters and organisms associative to a chemical product, according to the German regulation. The new products Polyfoamer ECO/100 and Polyfoamer ECO/100 Plus are characterized by lower values of COD at the initial stage when compared to traditional products, meaning that their provision of organic material to the conditioned soil is lower. 2. Environmental results with soils conditioned with the Polyfoamer ECO products Various laboratory tests have been carried out with the new foaming agents of the Polyfoamer ECO line of products and samples of soil coming from different TBM projects. The results obtained with two samples of soil from an Italian project are described: the material called “M” (a
Analytical and ecological characterization of soil and surface water samples collected in urban areas downstream of construction sites (2006-2007) for assessing the environmental risk of SLES residues.

**WE039**

**Preliminary environmental risk assessment of sodium lauryl ether sulphate contained in foaming agents used in mechanized tunnelling**


Mechanized excavations using Tunnel Boring Machines (TBM) has consolidated in the recent years as a by-product. The main results obtained with the Polyfoamer ECO/100 and Polyfoamer ECO/100 Plus are: lower toxicity and lower content of organic material when compared to traditional foaming agents, faster degradation of the surfactants inside the conditioned soil, low toxicity of the conditioned soils and tendency of toxicity decrease along the time.Values comparable to the natural soil toxicity are achieved in a short period.

We obtained many results which have been recently characterized. For this purpose, eight bins containing S1 or S2 conditioned separately with the two foaming agents, were weekly turned to improve aeration, while the corresponding eight blends were not turned. At selected times (0, 4, 7, 12, 20 and 28 days), soil and leachate samples were collected from the bins for assessing SLES concentration by MBAS spectrophotometric method, preceded by ASE (Accelerated Solvent Extraction) in the case of the soil matrix. The results showed that residual SLES concentration in soil and in leachate is dependent both on the type of soil and on the nature of polymers.

**WE040**

**Ecotoxicological assessment of spoil material produced in mechanized tunnelling**


The mechanized of the tunnelling industry by EPB-TBM (Earth Pressure Balance - Tunnelling Machines), results in a wide use of foaming agents and polymers as lubricating products for soil conditioning. Anionic surfactants, sodium lauryl ether sulphate (SLES) is the most utilised compound in the commercial products for the excavation industry. Significant amounts of rock broken into various sizes mixed with anionic surfactants are produced during the excavation of execution works. The potential re-use of this non-renewable natural resource, for example as land covering, depends on the assessment of its environmental compatibility; otherwise, the spoil materials must be treated as waste. In this context, it is important to evaluate the residual concentrations of SLES in the excavated soils in order to evaluate their possible final destination. Given the absence of official analytical methods, it has become necessary to develop and validate a reliable and accurate methodology to quantify anionic surfactants in the spoil materials and, more in general, in the environmental solid matrices. For this purpose, the aim of the present work was the optimization of an analytical method for the determination of SLES in conditioned-soil samples. It consists of a first phase of extraction of anionic surfactants from the soil by the use of Pressurized Liquid Extraction (PLE) and the following analysis in the extract by the MBAS (Methylene Blue Active Substances) method using the water official method partially modified. The optimised method has been applied to real excavated soil samples because the determination of residual concentrations of the anionic surfactants in the spoil materials produced during excavation process, is currently one of the mandatory parameters for assessing their eco-compatibility.
These excavation rocks are made of rock fragments contaminated by the additives used in mechanized tunnelling: effects on air, water, and soil. The main components are made of quartz, feldspar, and clay minerals, which are naturally present in the spoil. This study highlights the importance of a site-specific ecotoxicological evaluation in the tunneling projects in order to have a real environmental compatibility of the spoil material.

**WE041** Experiments for on-site monitoring activity in mechanized tunneling applications


In the vast majority of tunnel projects performed with TBM-EPB technology a key issue is currently represented by the disposal management of the spoil, huge amount of excavated material mainly composed by the natural soil, water and chemical injection residues. Thus, the need arises to plan strategies to avoid negative impacts to the conditioned soils. The aim of this study is to evaluate the effect of specific concentration values of these chemicals on terrestrial and aquatic environments, as well as to measure the reduction of the concentration of these compounds in each environment due to the action of the microorganisms inhabiting them. All these experimental procedures must be carried out in specialized laboratories equipped with sophisticated apparatuses, in which conditioned environments are predisposed, so that at present it’s not possible to measure the level of pollution through expedient tests directly on site. A joint research activity between Sapientia University and National Research Council of Rome has developed a test procedure able to provide expedient information on the presence in the spoil of the chemicals often used in mechanized tunneling. The results of preliminary laboratory tests convinced that the expeditious assessment proposed can describe the amount of chemicals in the soil and their evolution in time, complementing the laboratory activities currently accepted. In fact, this fast procedure must be regarded as a first screening which can be run directly in site on a large number of samples without the use of expensive, delicate or complex instruments, to be used in combination with few more precise laboratory tests. Monitoring tests are seen as being suitably suited for monitoring large volumes as those involved in tunnel excavation. The intention for the future is to apply the procedure to real cases to verify, through a comparison with the most accurate laboratory tests, the actual effectiveness of this procedure.

**WE042** Toxicity of several additives used in mechanized tunneling: effects on daphnids, algae and cress.

D. Baderna, S. Maiorana, A. Passoni, R. Baglioni, Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; M. Lodi, E. Benfenati, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences

Surfactants and polymers are used in mechanized tunneling to facilitate the excavation and to preserve the tunnel boring machine (TBM) from wear, block and break. As a by-product of the process, several tons of rocky debris are produced. These excavation rocks are made of rock fragments contaminated by the additives such as anionic surfactants, glycols, sealants, polycrylates and polycrylamides. In the past, rocky debris were disposed as waste with a large economic impact on total excavation cost, while some disposal alternatives were recently applied, trying to recycle these complex materials as road filling material, covering rocky areas or river banks. These disposal solutions, however, have attracted the attention of regulators and environmental protection agencies, especially in Italy. In fact, the toxicity of these active mixtures is not yet fully known as well as the potential effects arising from the simultaneous presence of additives with other regulated environmental contaminants such as, for example, metals and hydrocarbons. A preliminary study recently conducted by our group on three commercial TBM additives showed toxic effects on the aquatic ecosystem in concentrations comparable to those resulting from excavations carried out in Italy. This new study analyzes 8 surfactants and 4 commercial polymers, using a multidisciplinary approach to determine their reference thresholds for both water and soils, accounting of the effects on ecological targets. The chemical composition of the technical mixtures was determined by liquid chromatography coupled with high resolution mass spectrometry. The main chemical components were analyzed in silico to highlight the potential similarity with other pollutants, already listed in our environmental framework regulation. Finally, the toxicity of the various agents has been evaluated by tests with Daphnia magna, freshwater algae and cress. Chemical characterization identified 15 molecules present in all the surfactant mixtures, although in different proportion. No similarities with compounds already regulated by the Italian Environmental Act were found by the in silico analysis. All the tested surfactants were toxic for the aquatic organisms at concentrations comparable to those that can be found in leachates of conditioned rock debris. The additives resulted non toxic for the terrestrial plant at concentrations theoretically found in conditioned rock debris.

**PTB/vPvB & PMT/vPvM substances and Non-extractable residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (P)**

**WE043** Bioaccumulation, tissue distribution, and trophic magnification of organic ultraviolet absorbents in freshwater ecosystem in the Pearl River catchment, China

X. Peng, Z. Zhu, S. Xiong, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences

Bioaccumulation and trophic transfer of 13 organic ultraviolet absorbents (UVAs) were investigated in riverine wildlife organisms in the Pearl River catchment, South China. The UVAs were widely present in the fish with the highest level detected for UV 531. Generally, the UVAs concentrations were higher in the freshwater fish than in shrimp. Dietary habits of the fish showed effects on bioaccumulation of the UVAs with higher levels in the carnivorous species than in the herbivorous, planktivorous and detritus feeding fishes. Tissue distributions were generally in the order of liver > belly fat > muscle. Obviously higher concentrations of 2-ethyl-hexyl-4-trimethoxycinnamate were detected in eggs than in muscle, probably indicating maternal transfer of the compound. The calculated bioaccumulation factors (LogkBA)were usually > 3.3, suggesting potential of biomagnification of the UVAs in the freshwater fish. UV 531 showed tendency of bioaccumulation in the fish from the sediment indicated by the calculated BSFA > 1. The estimated trophic magnification factors were > 1 for some benzotriazole stabilizers, suggesting potential of biomagnification of the UVAs in the freshwater fish.

**WE044** Hyalella azteca as non-vertebrate alternative species for bioaccumulation studies

M. Habekost, BASF Corporation; N. Kreling, BASF SE / Crop Protection - Ecotoxicology; B. Kusebauch, M. Obermann, BASF SE Agrarzentrum Limburgerhof

Bioaccumulation is one of the PBT (persistence, bioaccumulation, toxicity) cut-off criteria for plant protection products (EC/1107/2009) in the EU; furthermore, high bioaccumulation is generally considered a critical parameter in other regions, too. The standard regulatory assessment of bioaccumulation is based on bioconcentration in aquatic species, i.e., for regulatory purposes in fish. However, standard fish bioconcentration studies are time consuming, expensive and they use a considerable number of vertebrate fish. Therefore, there is a need for a relatively quick, cheap, and preferably alternative test method that enables the ranking of structurally clustered candidate molecules regarding bioaccumulation potential and the prediction whether a candidate molecule will exceed the BCF (bioconcentration factor) trigger value. Furthermore, Hyalella azteca might in the long-term perspective be able to replace fish for BCF testing. There is indication that experimental BCF values from through bioaccumulation studies with Hyalella are similar to those obtained from fish (Schlechtriem, 2012). Further work is presented in order to (i) increase the data base of Hyalella – fish BCF data sets covering a wide range of BCF values (i.e. 100 to 20,000), (ii) to standardize and simplify the test system and (iii) to check the suitability of the test system for molecules with an insecticidal mode of action which poses inherent challenges since Hyalella as an aquatic invertebrate can be quite sensitive. The results from
Bioaccumulation of ionizable organic chemicals in fish - The quest for reliable predictors

Several BCF studies with *Hyalella* supports this species as suitable test species for bioaccumulation testing and supports planned activities on OECD level.

**WE045**

Bioaccumulation of ionizable organic chemicals in fish - The quest for reliable predictors

F. Pohland, Technical University of Denmark (DTU) / DTU Environment; Z. Zhang, Technical University of Denmark / DTU / DTU Environment; K. Bittermann, Helmholtz Centre for Environmental Research GmbH / UFZ - Analytical Environmental Chemistry; L. Linden, UFZ - Helmholtz Centre for Environmental Research / Department of Analytical Environmental Chemistry; C. Schlechtliem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; K. Goeldl, Helmholtz centre for environmental research - UFZ / Analytical Environmental Chemistry; S. Trapp, Technical University of Denmark / DTU / DTU Environment

Dietary bioaccumulation in fish is quantified using biomagnification factors (BMFs), which are derived under controlled conditions according to OECD guideline 305-III. To reduce in vivo experimental efforts, pre-screening using statistical models for BCF prediction is becoming increasingly popular. While dietary bioaccumulation of neutral chemicals has been successfully associated to lipophilicity descriptors, no suitable predictor has yet been identified for ionizable chemicals. In this study, we investigated the capability of selected chemical properties (e.g., molar volume, adsorption to albumin, lipophilicity, solubility, topological polar surface area) to predict bioaccumulation of organic electrolytes in fish with specific focus on dietary exposure studies. Measured dietary BMFs were collected from existing literature, and empirical correlations with measured or estimated chemical descriptors were evaluated. The dataset includes dietary BMFs in whole fish obtained under laboratory-scale conditions closely resembling or directly referring to the OECD 305-III guideline. In total, BMF data were available for 29 ionizable chemicals (of which 10 are perfluorinated chemicals), including 24 acids and 5 tetranorlabdane diterpenoids, for which a significant negative correlation was shown when logKOW was used as the predictor (R < 0.40). BMFs for this set of compounds are comparable to those found in the literature, but the statistical model has to be used with caution when predicting dietary BMFs for ionizable chemical compounds.

**WE046**

Evaluation of a tiered approach for the bioaccumulation assessment of fragrance substances: in silico, in vitro assays, invertebrate vs. in vivo fish bioconcentration test

S. Gimeno, Firmech / Product Safety and Regulatory Affairs; V. Lauschker, F. Berthaud, Firmech SA / DRAS; I. Bischof, Fraunhofer Institute for Molecular Biology and Applied Toxicology IME / Bioaccumulation and Animal Metabolism; C. Krofft, University of Bern / Centre for Fish an Wildlife Health; H. Segner, University of Bern / Centre for Fish and Wildlife Health; H. Schug, Eawag Swiss Federal Institute of Aquatic Science and Technology; K. Schirmer, Eawag / Environmental Toxicology; F. Begnud, Firmech / DRAP

Bioaccumulation is a key end point in environmental hazard and risk assessment, especially for substances with a high octanol-water partition coefficient (logKOW). To measure the Bioconcentration Factor (BCF), a tiered approach is followed starting from the assessment of the octanol water partition coefficient as a measure for lipophilicity, which is often used as surrogate for lipid partitioning up to an experimental BCF value which is considered as the gold standard for fish bioaccumulation assessment. We have applied a series of non-animal tests to predict the BCF values and compared those outcomes to the results from a BCF test in order to validate this alternative approach. Several fragrances from the tetranorlabdane diterpenoids family, either composed of a single or a mixture of isomers, is noted to be non-bioaccumulative, and supports the in vitro biotransformation findings. Histopathological results from toxicological studies showed liver hypertrophy consistent with the increased metabolism associated with detoxification processes. A tiered-weight-of-evidence approach is clearly justified for the current bioaccumulation assessment, confirming that the tests described in the abstract may offer alternatives to animal testing when sufficient and supportive evidence is provided.

**WE047**

Proposal for a freshwater trophic magnification study based on a Comprehensive literature evaluation

V. Kosfeld, Fraunhofer Institute for Molecular Biology and Applied Ecology IME / Bioaccumulation and Animal Metabolism; H. Ruedel, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Department of Environmental Monitoring; C. Schlechtliem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; C. Rauet, Umweltbundesamt / International Chemicals Management Division, Bundesanstalt für Naturschutz und Naturschutzforschung (BfN)

The bioaccumulation potential is a critical property used for the risk assessment of chemicals and is usually expressed by parameters derived from laboratory or field experiments, in particular bioconcentration-, bioaccumulation- and biomagnification factors. A relatively new approach is the determination of so-called trophic magnification factors (TMF) which integrate enrichment factors from different food web levels. In order to validate this alternative approach, several fragrances from the tetranorlabdane diterpenoids family, either composed of a single or a mixture of isomers, is noted to be non-bioaccumulative, and supports the in vitro biotransformation findings. Histopathological results from toxicological studies showed liver hypertrophy consistent with the increased metabolism associated with detoxification processes. A tiered-weight-of-evidence approach is clearly justified for the current bioaccumulation assessment, confirming that the tests described in the abstract may offer alternatives to animal testing when sufficient and supportive evidence is provided.
An approach for the evaluation of PBT/vPvB substances subject to the consequences on the PBT/vPvB-identification.

WE049 PBT/vPvBs: All equally bad or some worse than others? - How to inform risk management

K. Thiele, WUR; S. Gabbert, Wageningen University / Social Sciences

In the risk management of chemicals there is an increasing demand to assess the economic, social and environmental impacts of regulatory measures in order to facilitate political decision-making. Within REACH, socio-economic analysis (SEA) is the tool to assess and balance positive and negative impacts of different policy options. Currently, persistent, bioaccumulative and toxic (PBT) and very persistent, very bioaccumulative (vPvB) chemicals are regulated on the basis of their different properties. These imply a high and long-lasting damage potential for the natural environment. In reality, however, it is likely that PBT/vPvB are not of equal concern in terms of their damage potential to humans or ecosystems. The lack of knowledge on the actual effects of PBT/vPvB chemicals in the environment hampers the estimation of their risks and, in turn, a full quantification of all impacts. Consequently, a fundamental challenge for SEA is to adequately describe the regulatory concerns of PBT/vPvB chemicals, and to integrate specific information on a certain PBT/vPvB substance into a metric that informs policy-makers on their potential impacts. So far, there is no systematic approach on how available hazard and risk data as well as complementary information about the uncertainty due to data quality or lack of knowledge, can be used to assess the difference in damage potential of PBT/vPvB chemicals in SEA. Exploring the perspectives of experts from academia, industry and regulatory agencies may thereby be helpful to guide the development of approaches for comparative evaluations of PBT/vPvB substances. This poster proposes a research project that is going to explore how specific characteristics of PBT/vPvB chemicals can influence the concern. Based on surveys and structured interviews, it will examine what parameters are considered most relevant to characterise the concern of PBTs/vPvBs. Furthermore, it will be explored how experts in academia, industry, regulatory agencies rate the relative importance of different (sets of) characteristics of PBT/vPvB substances in terms of their environmental impact potential. The results can be used to inform cost-effectiveness analyses and ranking schemes for PBTs/vPvBs. This will, ultimately, facilitate comparative evaluations of PBT/vPvB substances for SEA and regulatory decision-making.

WE050 Modelling Persistent & Mobile Organic Compounds using an updated Multimedia Urban Model: A Toronto Case Study with Organophosphate Esters (OPEs)

T.F. Rodgers, University of Toronto / Chemical Engineering and Applied Chemistry; L. Jantunen, Environment and Climate Change Canada; P.A. Helm, Ontario Ministry of Environment and Climate Change / Environmental Monitoring and Reporting Branch; M.L. Diamond, University of Toronto / Department of Earth Sciences

Organophosphate Esters (OPEs) are a group of chemicals found at relatively high levels in the environment, both as an intentional, a polymerization byproduct. The usage of OPEs has increased in recent years following the listing of penta- and octa-BDEs as POPs under the Stockholm Convention. In contrast with BDEs, OPEs highly polar molecules which can be considered persistent and mobile organic compounds (PMOCs). We modified the Multimedia Urban Model (MUM) of Diamond and co-workers by using polyparameter linear free energy relationships (ppLEERs) to represent partitioning, and it will be explored how experts in academia, industry, regulatory agencies rate the relative importance of different (sets of) characteristics of PBT/vPvB substances in terms of their environmental impact potential. The results can be used to inform cost-effectiveness analyses and ranking schemes for PBTs/vPvBs. This will, ultimately, facilitate comparative evaluations of PBT/vPvB substances for SEA and regulatory decision-making.

WE052 Polymers: The Next Frontier in Environmental Hazard Assessment

A. Carras, Kao USA / R&D; T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; I. Davies, Personal Care Products Council / Science; J. Coleman II, Kao USA

Polymers are a very large and diverse class of chemicals widely used in cosmetic and personal care products. Their use and function are essential in creating high performing products that meet the needs of consumers. As used in cosmetic formulations, polymers can act as thickeners, emulsifiers, conditioners, opacifiers, film formers, rheology modifiers, etc. In the simplest terms, according to the Oxford Dictionary, a polymer is a substance that has a molecular structure consisting chiefly or entirely of a large number of similar units bonded together. They have a full range of physical-chemical properties including a wide breadth of solubility and molecular charge, for example. Currently, the majority of large molecular weight polymers are exempt from chemical regulations around the world (e.g. REACH) or are largely considered of low concern based on a minimum set of physical-chemical properties. The Environmental Technologies Framework (ETF) provides a framework for use of new and novel approaches for filling environmental hazard data gaps in order to create a robust environmental hazard assessment. This poster will examine the current polymer landscape for cosmetic uses, identify common data gaps, provide possible solutions to fill those data gaps, and offer a prioritization scheme for future testing of polymers. Ultimately, the objective is to suggest a more modern approach to substantiating the environmental safety of the large variety of polymers used in cosmetic and personal care products.

WE053 A consistent Approach for PBT/vPvB Assessment for Pharmaceutical Products

E. Nfon, Smithers Viscient / Department of Regulatory Affairs; K. Malekani, Smithers Viscient / Environmental Fate and Metabolism.

Keywords: Persistence, bioaccumulation, Toxicity, Pharmaceuticals Track 6: Environmental policy, risk management, and science communication.
requirements, strategies and challenges. Abstract A PBT substance is one that is persistent (P), bioaccumulative (B) and toxic (T) or very persistent (vP) and very bioaccumulative (vB). The PBT assessment approach is well described under the REACH regulation (Regulation EC No 1907/2006) starting with a screening process based on available data and when a potential PBT is identified, then a definitive assessment is required. While this procedure is clearly understood for industrial chemicals, regulation of pharmaceuticals under REACH is different for pharmaceuticals. There is no definitive PBT/vPvB guidance for pharmaceuticals from the European Medicines Agency (EMA), although it is recommended that the assessment be made according to REACH criteria. Application of the REACH guidance to the PBT assessment of pharmaceuticals is not straightforward. A PBT evaluation of a substance is triggered within REACH if more than 10 tonnes of the substance is used per year. There is no established trigger value for performing a PBT assessment for pharmaceutical products, although it appears that a PBT assessment is applicable to pharmaceutical products that go into Phase II. However our experience is that there is room for interpretations during the review process – especially for products that end at Phase I. Some RMS have consistently rejected the use of all available data; especially data derived from QSARs and instead treat the product as a potential PBT. Furthermore, we are currently discussing additional information on the regulatory consequences of the PBT-assessment for any given product, the situation may change in the future. It is our hope the EMA will issue clear guidance on how a PBT/vPvB assessment should be performed for pharmaceutical products and the consequences for products which fulfil the PBT/vPvB criteria. This presentation will describe our experiences and the chemicals we have encountered in performing PBT/vPvB assessments for pharmaceutical products, including an overview of typical review comments from Co-(Rapporteur) are discussed. We also discuss review options for the improvement of PBT/vPvB assessment for pharmaceuticals.

WE054 Evaluation of new assessment methods and enhancement of PBT/vPvB criteria for ionisable substances H. Holzmann, RWTH Aachen University; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

The identification of persistent (P) bioaccumulative (B) and toxic (T) substances under the EU regulation REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) was developed to assess neutral organic compounds. However, nearly 50 % of the chemicals pre-registered at the European Chemicals Agency (ECHA) are partly or completely ionised under environmental conditions (Franco et al., 2010). Since the charge of chemicals strongly influences their properties and environmental behaviour, the currently valid concept under the REACH regulation does often not offer a sufficient assessment of ionisable substances. The objective of the project is to refine the P assessment of ionic and ionisable substances under REACH. For this purpose, simulation studies following OECD guidelines are conducted using two different types of environmental compartments: Aerobic and Anaerobic Transformation in Aquatic Sediment Systems (OECD 308) and Aerobic Mineralisation in Surface Water (OECD 309). As models, the substances are three radiolabelled surfactin assays for which solely differ in their polargroup: 4-n-dodecyl phenol (DP), 4-n-sodium dodecylbenzenesulfonate (DS) and 4-n-dodecylbenzytrimethylammonium chloride (DA*). Sediment and surface water were collected from a rainwater detention basin in Aachen, Germany. Preliminary studies using DP and DS were performed according to OECD 308 and 309. In the water-sediment system, formation of non-extractable residues (NER) was 13 % for DP and 10 % for DS after 65 days. The amount of 14CO2 was 48 % (DP) and 63 % (DS). In surface water, about 40 % (DS) and 30 % (DP) of the initially applied amount of radioactivity was mineralised to 14CO2. Degradation studies with DA* are in progress and the results will be presented. The results will be used to refine the evaluation of the P criteria for ionic and ionisable chemicals in the PBT assessment. A unexpected challenge: ionizable compounds in the REACH chemical space. The International Journal of Life Cycle Assessment, 15(4), 321-325.

WE055 Assessment of the persistence of ionisable or ionisable organic chemicals under REACH D. Claassen, RWTH Aachen University / Institute for Environmental Research; J. Ackermann, Federal Environment Agency Umweltbundesamt / Chemicals; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics.

For the protection of humans and the environment, the identification and regulation of chemicals with persistent (P), bioaccumulative (B) and toxic (T) properties are central within the environmental assessment. The criteria for the identification of PBT substances under REACH (Registration, Evaluation and Authorization of Chemicals) (EU Nr. 1907/2006) and the guidance for the PBT-assessment have been developed for neutral organic molecules, and do not properly address charged chemicals. Due to their charge, ionic and ionisable substances seem to behave differently in the environment compared to neutral substances. With the addition of cationic, anionic or amphocharatic characteristics, the chemicals intrinsic properties (e.g. water solubility, log Kow) change as a function of the environmental pH. This dependency affects the distribution of these substances within environmental compartments. The ionic function may also lead to different interactions between organic or mineral solid particles and the substance, influencing their bioavailability for potentially decomposing microorganisms, which are governing biotical degradation. In order to improve the evaluation of the persistence of ion and ionisable substances in the PBT-assessment, sorption and degradation patterns of ionic substances have to be considered. Due to the higher chemical reactivity of charged and non-charged functional group will be investigated in the biodegradability behavior of 14C-labeled 4-n-Dodecylphenol, 4-n-Dodecylbenzenesulfonicacid sodium salt and 4-n-Dodecylbenzyltrimethylammonium chloride in soil simulation tests (OECD 307) will be investigated according to their mineralized, extractable and non-extractable fraction. Non-extractable residues will be investigated further. In addition, the sorption behavior of the model substances will be determined in a sorption study (OECD 106). The results will enable the estimation of the effect of the positive and negative charged groups within the molecule structure regarding the biodegradability and will improve the evaluation of the persistence of ionic and ionisable substances in the PBT-assessment.

WE056 Interaction of sulfonamide with soil humic acid: ESIR investigations with nitroxide spin label A. Ricke, E. Bondarenko, H. Steinhoff, University of Osnabrug / Physics; G. Ur, K. Hideg, T. Kalai, University of Pécs / Organic and Medicinal Chemistry; M. Mathies, University of Osnabrug / Institute of Environmental Research, Group of Hydrophobic Systems (OECD 308) and Aerobic Mineralisation in Surface Water (OECD 309). The amount of covalently bound sulfonamide with soil humic acid: ESR investigations with nitroxide spin label.

WE057 The role of non-extractable residues in the environmental risk assessment from regulatory perspective - requirements and challenges A. Wiemann, UBA Umweltbundesamt; J. Hoegback, Federal Institute of Hydrology; G. Speichert, German Environment Agency UBA; D. Gildemeister, Umweltbundesamt / German Environment Agency / IV2.2 Pharmaceuticals; D. Loffler, T. Ternes, German Federal Institute of Hydrology

Non-extractable residues (NER) are defined in different regulatory frameworks. In some cases NER are integrated in the calculation of predicted environmental concentrations (PEC) or are an issue in the authorisation decision. The significance of NER in the assessment of persistence (e.g. PBT, vBvP, POP classification) has been more or less neglected in the past. However, new developments as reflected in guideline revisions (e.g. ECHA R.11, 2017) highlight the importance of NER in the assessment of persistence and sorption of Chemicals can be reversibly bound to the soil/sediment and pose a potential risk to the environment or irreversibly bound which can be interpreted as sink. Hence, the potential release of parent or transformation products from NER in soil or sediment should be considered. However, distinguishing between these types of NER presents a challenge up to now. Standardised or commonly accepted extraction schemes or analysis techniques are not available due to the broad range of substances and soil/ sediment characteristics. A general classification for NER was proposed by Eschenbach (2013) based on a literature survey dividing NER into four types: type 1 (heavily sorbed fraction) and type 2 (physically entrapped fraction) are...
considered to be possibly remobilised in the environment. NER Type 3 (covalently bound residues) and type 4 (biogenic bound NER) are considered to be irreversibly bound to soil/sediment or transformed into biomass and therefore a risk to the environment is not anticipated. Furthermore, a stepwise extraction scheme is proposed which would allow the determination of these different NER types. The comprehensive scientific assessment of this extraction scheme supported by experimental research was funded by UBA.

Transformation tests in soil with 13C-labelled substances were carried out in accordance with the OECD 307 guideline. Different extraction methods and chemical breakdown procedures were performed and compared in order to characterise the formation of the different NER types. Under consideration of these results, a refined extraction scheme will be proposed with respect to the general applicability for definition of NER, and an extractable fraction for reversibly bound fractions have to be considered in assessment of the persistence. An UBA evaluation of regulatory data demonstrate the effects of several influencing factors (e.g. extraction methods, soil type) on NER formation.

**WE058 Sorption properties of Ionic organic chemicals: Correlations between ion exchange chromatography retention factors and environmental sorption coefficients**

S. Endo, Osaka City University / Urban Research Plaza & Graduate School of Engineering; L. Henneberger, Helmholtz centre for environmental research - UFZ / Cell Toxicology; K. Goss, Helmholtz centre for environmental research - UFZ / Analytical Chemistry

A common metric for the extent of equilibrium sorption and partitioning, such as the octanol-water partition coefficient (Kow) for neutral organic chemicals, does not exist for ionic organic chemicals. Finding a suitable reference sorption system for ionogenic organic chemicals should enhance the evaluation, modeling, and prediction of environmentally-relevant sorption coefficients for such chemicals. In this study, we considered synthetic ion exchange materials as possible reference for ion exchange, and compared their sorption properties against those of various environmental and biological materials. Retention times on commercial ion exchange chromatography columns were measured in fully aqueous eluent and were converted to retention factors (k'), which are proportional to the ion-exchanger-water partition coefficients. In the end, we established a data set for retention factors of 61 cations on a strong cation exchange column (SCX), 24 cations on a weak cation exchange column (WCX), and 66 anions on a weak anion exchange column (WAX) measured in consistent experimental conditions (i.e. pH, T, co-existing ions, injected amount). The obtained retention factors were compared to soil organic carbon-water (Koc), clay-minerals-water (KCM/w), bovine serum albumin-water (KBSA/w), and muscle protein-water partition coefficients (KMP/w) from the literature. Good correlation (R2 = 0.5-0.6) were found for some cases such as log Koc, log KMP/w, and log KBSA/w against log k' for WAX. For comparison, similar correlation analyses were performed using experimental and predicted log Kow instead of log k'. In most cases, the correlation with log Kow were lower than the correlation with log k'. Notably, log k' has a clearly larger applicability domain than log Kow, because cases, the correlation with log Kow were lower than the correlation with log k'.

**WE059 Simulation of the fate of co-labelled 13C3-15N-glycophosphate in a water-sediment system and formation of biogenic non-extractable residues**

A. Brock, DTU Environment / DTU Environment; A. Rein, Technische Universität München / Chair of Hydrogeology; F. Poliesl, Technical University of Denmark (DTU) / DTU Environment; K. Nowak, TU Berlin / Institute for Environmental Research (Biology V); M. Künster, Helmholtz centre for environmental research - UFZ / Department of Environmental Biotechnology; S. Trapp, Technical University of Denmark / DTU / DTU Environment


**WE060 Determination of persistent organic pollutants (POPs) in soil from sites adjacent to landfills: different provinces of the Republic of Armenia**

A. Arakel, Ararat University / Hazardous Substances & Waste Policy Division / Head of Division; Y. Buinyayyan, Environmental Monitoring and Information Center / Division of waste inventory, classification and technology investigation; V. Khachatryan, National Institute of Oncology / Thoracic Surgery Department; F. Petrosyan, UNIDO BAT/BEP Project(Armenia)

Sources of environmental pollution by persistent organic pollutants (POPs), either used directly or directly applied to pesticide include landfills, many of which do not meet sanitary and hygienic standards and, at open burning of wastes, become a source of dioxins and furans. Investigation was carried out on soil samples taken in different marzes (provinces) of the Republic of Armenia at the boundaries of landfills and agricultural lands or water basins in the vicinity of towns Ararat (Ararat Marz), Hrazdan (Kotayk Marz), Sevan (Gegharkunik Marz), Garni (Ararat Marz), Amaghu (Syunik Marz). The obtained soil samples were analysed for determination of the following POPs: - Hexachlorocyclohexane (HCH) isomers: α-, β-, γ-, δ-HCH; - DDT isomers: 2,4’- DDT, 4,4’-DDT, 2,2’-DDE; - DDT metabolites: 2,4’-DDE, 4,4’-DDE, 2,4’-DDE; - Hexachlorobenzene, - Heptachlor, - Aldrin - Dieldrin - Heptachlor epoxide A and Heptachlor epoxide B, - Endosulfan I and Endosulfan II, - Endrin, - Mirex; - 14 Dioxin-like polychlorinated biphenyls: congeners No. 77, 81, 105, 114, 123, 126, 156, 157, 167, 169, 170, 180, 189. Quantification of POPs was done using chromatograph with electron capture detectors (ECD) equipped with glass capillary column with stable phase DB–5MS UI and the following parameters: 60 m x 0.25 mm x 0.25 μm. Special attention was paid to the total concentrations of HCH isomers, DDT isomers and metabolites, as well as the total amount of polychlorinated biphenyls, as maximum allowable concentrations (MACs) are set for the aggregate amount of these compounds. On the analogy, concentrations of other POPs pesticides and all studied POPs are also considered on the whole (summary concentrations) as obvious integral indicators of soil pollution by the studied POPs. In the investigated soil samples HCH isomers, DDT isomers and metabolites, certain Dioxin-like polychlorinated PCBs were detected at concentrations exceeding the established norms.

**WE061 Improving the interpretation of Non-Extractable Residues (NER) in degradation assessment**

A. Trapp, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Kaestner, Helmholtz Centre for Environmental Research UFZ / Dept Environmental Biotechnology; S. Trapp, Technical University of Denmark / DTU / DTU Environment

Criteria for the assessment of chemical properties, potential (eco)toxicity, and environmental behaviour of industrial chemicals in general, and particularly for REACH substances, biocides, pesticides, and veterinary medicines are summarized in specific European legislations. The regulatory views on NER formation differ considerably, with two extremes of assuming them as either degraded residues of no environmental concern or as bioavailable and non-degraded residues. This may be changed if clear indications for ultimate degradation or irreversible stabilization are available or necessary. Such research is required on how the different types of NER of chemicals in environmental matrices can be experimentally discriminated, sequestered (strongly sorbed and entrapped) residues (type I), containing the parent compound or transformation products or both and having the potential of release. Type II NER are residues that are covalently bound to organic matter in soils or sediments or to biological tissue in organisms. Such residues are considered potential (eco)toxicological matters, as well as the total amount of non-extractable residues (NER) was covalently bound to organic matter in soils or sediments or to biological tissue in organisms. Such residues are considered potential (eco)toxicological matters, as well as the total amount of these compounds. On the analogy, concentrations of other POPs pesticides and all studied POPs are also considered on the whole (sumary concentrations) as obvious integral indicators of soil pollution by the studied POPs. In the investigated soil samples HCH isomers, DDT isomers and metabolites, certain Dioxin-like polychlorinated PCBs were detected at concentrations exceeding the established norms.
II NER and type I NER should be considered as potentially releasable residues in persistence assessment but the probability of type II release is much lower. For these types the potential of remobilization needs to be tested and evaluated. Our concept is to consider the total amount of NER minus bioNER as the amount of potentially remobilizable xenonNER (type I + II). If a clear differentiation of type I and type II is possible and the latter is irreversibly bound, only type I NER needs to be considered in the persistence assessment. If no characterization of NER is available, we recommend to assess the total amount as potentially remobilizable.

The use of pesticides has allowed for increased crop productivity in agriculture. However, because of their frequent application onto agricultural lands, their environmental fate is of particular interest. Pesticides have been ubiquitously detected in natural waters throughout Europe as well as in water supplies, which suggests these pesticides may be more mobile and persistent than their initial evaluations indicated. A potential reason for the mischaracterization of these pesticides’ persistence and fate is the environmental fate of xenobiotic pathways in the environment. For example, only direct photolysis in pure water can be considered, but the presence of dissolved organic matter can significantly affect the photolytic fate of pesticides in natural water. The photolytic degradation can either be enhanced by indirect photolysis reactions with photochemically produced reactive intermediates (e.g., triplet state dissolved organic matter, single oxygen radical, hydroxyl radical), or it can be suppressed by the light screening effect of organic matter once the light enters the water column. This research focused on the photolytic fate of fungicides, which account for approximately half of pesticide usage in Europe, in natural waters. For the several commonly used fungicides investigated, the results show that both direct and indirect photolysis are important to quantify in order to accurately characterize the environmental fate of fungicides.

In this study, a new natural degradation pathway of atrazine and the potential mechanism are proposed. Atrazine was oxidized under simulated solar irradiation by indole-3-acetic acid at the environmentally relevant concentration under aerobic condition. The reaction was initiated by the production of hydrated electrons generated from the photoreduction of indole-3-acetic acid, and then this species transformed into hydroxyl radical after a series of radical reactions with proton and dissolved oxygen. During this process, the presence of montmorillonite greatly enhanced the yield of hydrated electron and promoted the further degradation of atrazine by hydroxyl radical. The novel reaction is to some extent affected by pH and the type of exchangeable cation present on montmorillonite. Based on our results, an index of knowledge to extrapolate to several other systems (laboratory studies) to the complex environment. As the first step of our undertaking to develop methodologies to extrapolate laboratory data to the aquatic environment, we chose a fragrance ingredient, Myrrhone, as an example, and used laboratory study results to calculate its photodegradation half-lives at depths in natural waters. Direct photodegradation was revealed to be the dominant photodegradation process of Myrrhone, but the quantum yield was determined to be 0.51 in the laboratory. Four main volatile photodegradation products, which continued to photodegrade, were observed, isolated by preparative multidimensional GC and identified using NMR. Direct photodegradation half-lives of Myrrhone in natural waters at different depths were calculated based on its molar absorption spectrum, quantum yield, and the irradiance at depth of natural waters. The irradiance values at depth were obtained by applying diffuse attenuation coefficients (Kd) to the irradiance at the surface of water, generated using a solar irradiance calculator as a function of time, date and location. Kd are empirical values determined by the interaction of a number of factors, including absorbance by dissolved organic matter and particulate matter, scattering, and the angular distribution of the light field. A correction factor for clear water was used for the calculation of the step of each half-life which ranged from 1.3 to 9.1 days for small size lakes and 6.3 to 45 days for large size lakes under realistic conditions in Australia. The calculation of half-lives at the surface of water was validated by two outdoor photolysis experiments. The calculated half-lives of 0.38 h and 1.14 h were in agreement with the measured half-lives of 0.40 h and 1.15 h, respectively. This agreement indicated that mathematical models can be developed to define complex environmental conditions for the extrapolation of laboratory data to the environment. The next step is to design experiments to measure half-lives at depth in natural water to refine and validate the calculation of half-lives. Thoroughly validated models can be valuable tools for the persistence assessment of chemicals based on photodegradation information.
WE067
In silico Tools to Assess the Confidence of QSAR Model Predictions
K. Kuhl, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry; S. Kutsarova, O. Mekenyan, University of Zlatarov / Laboratory of Mathematical Chemistry; G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry; L. Vierke, German Environment Agency / Chemicals; M. Neumann, Helmholtz Centre for Environmental Research - UFZ / Department of Ecological Chemistry

For the regulatory acceptability of QSAR predictions solid information about the reliability of the applied models is crucial. This regards the model in general as well as the particular prediction for a certain chemical. The presented study provides computerized tools to support the assignment of prediction reliabilities. The first topic of concern is the applicability domain. Generally, the applicability domain comprises various aspects. The focus of this presentation is on the mechanistic domain and on the chemical domain in terms of structures and substructures. In particular, the application of atom-centered fragments (ACF) is demonstrated. While ACF characterization of the general structural domain of a training set is established already, the approaches shown here provide more specific information about the reliability of a prediction. On one hand, this is achieved by extending the ACF characterization beyond the training set. Furthermore, data sets are separated into subsets with regard to performance or value ranges, and these subsets are employed to derive advanced reliability indicators. Secondly, automatically obtained model selectors can assist in selecting the presumably best-performing model from a model suite for a certain chemical depending on its structure and properties. Model selectors in this regard are computed scores derived from application of the model suite to chemicals with known experimental data. Thirdly, consensus modelling strategies are presented and examined to compensate for individual model errors. When combining predictions from different models, consensus outcomes can accordingly increase the levels of confidence, while conflicting outcomes are indicating lower reliabilities. In this respect, specific indicators have been developed in silico methods Ecological Chemical suites, and consensus approaches contribute to weight of evidence assessments. For all three aspects, working tools will be presented, and their performance will be demonstrated via examples from existing models and data sets. Acknowledgment: This study was financially supported by the European Union 7th Framework Program SOLUTIONS (FP7-ENV-2013) of the under grant agreement no. 603437.

WE068
Data Gap filling with ECOSAR in K-REACH compliance, a limitation and weakness
J. Ra, Korea Institute of Industrial Technology / Environmental Science and Engineering; H. Park, Korea Institute of Industrial Technology; S. ok, Kitech / REACH & Risk assessment

ECOSAR is a computer based QSAR program developed by US EPA within the regulatory constraints of the TSCA. However, it is also used in the other country or organization such as EU, Korea, OECD, etc. for their regulatory purpose. We introduced ECOSAR program to generate toxicity data and fill the data gap for developing species sensitivity distribution of 20 organic compounds. However, ECOSAR shows more pragmatic than theoretical characteristic. Thus, we investigated whether this model shows acceptable results on the deficient data of 20 organic compounds or not. Therefore we collected published data for fish and daphnia available and compared their geometric value to the output of ECOSAR. Some chemicals show similar output value to experimental data within double scale box, while others show very large difference of 1,400 times higher value in ECOSAR output. The least predictable substance is acrylic acid where 4 experimental data are used for the geometric mean value. On the contrary, methyl hydrazine shows almost no output. The least predictable substance is acrylic acid where 4 experimental data are used for the geometric mean value. On the contrary, methyl hydrazine shows almost no output. Therefore, the results shows whether water treatment processes have been addressed successfully. An overview of these regulatory challenges is provided with intermediate recommendations to address water treatment processes for active substance approval.

WE070
Water Treatment - A Regulatory Challenge under Regulation (EC) No 1107/2009
F. Schnitzler, S. Dorn, J. Wilbuer, Dr Knoll Consult GmbH

Regulation (EC) No 1107/2009 aims to protect humans and the environment and lays down rules for the authorisation of plant protection products in commercial form and for their placing on the market, use and control. Plant protection products consist of or contain active substances, i.e. the molecules or materials responsible for the action against the target pest, weed or fungal. Ozonation and chlorination are primary disinfection processes for central water treatment. Metabolites of certain active substances were found to react during ozonation of drinking water and to form by-products with toxic, carcinogenic and genotoxic characteristics. During the approval process of active substances, data gaps have recently been identified by EFSA regarding Article 4, 3(b) of Regulation (EC) No 1107/2009: A plant protection product ... shall have no immediate or delayed harmful effect on human health ... directly or through drinking water (taking into account substances resulting from water treatment).... In contradiction, water treatment processes are not implemented in the data requirements (Reg. 283/2013 or 284/2013) and no guidance documents for non-experimental tail testing and the choice of oxidant or oxidants are already in the solvent for quantitative analysis. The removal of analytes from aqueous solution was verified by comparing UV-Vis spectra in the range 240-360 nm before and after extraction in isooctane and then, has been quantified with capillary gas chromatography-triple quadrupole mass spectrometry. Results reveal better extraction by micelles than traditional method, mostly more interesting are binary system of surfactants, i.e. cationic-nonionic, anionic-nonionic. It was found that solubilization of analytes increases with increasing hydrophobicity of surfactant. Therefore, the aim of this study is to improve this method comparing solubilization capability of these surfactants based on different number of ethylene oxide units in nonionic surfactants, tail length and presence of ethyl or benzyl groups in cationic and anionic surfactants in order to optimize recovery of pollutants and minimize the quantity to be used in environmental monitoring programs.
article 57(f) of REACH based on a demonstrated equivalent level of concern (ELoC) as PBT or vPvB substances. In order to identify PMT as a substance of ELoC it must be demonstrated that there is "scientific evidence of probable serious effects to human health or the environment which give rise to an equivalent level of concern" and that there is evidence from a risk based considerations that the substance may cause serious effects during use and after through consideration, it should be demonstrated that the substance meets the criteria for the candidate list. On the candidate list is the most effective management strategy. With the protection of drinking water, and the pristine water bodies in mind, both bioaccumulation and mobility of persistent chemical substances are non-desirable. The environmental effect felt by bioaccumulative and mobile chemical substances varies both temporally and spatially, where mobile compounds can potentially accumulate in semi-closed drinking water cycles, while bioaccumulative compounds are able to accumulate in a closed loop system. vPvB can accumulate in food chains over time while vPvM can accumulate in pristine environments over time.

WE072 How many vP/vM/PMT substances have been registered under REACH? - vPvM/PMT screening by using the Danish QSAR database.

R. Holmberg, Danish EPA / Chemicals; E.B. Wedebye, N.G. Nikolov, Technical University of Denmark (DTU) / Division of Diet, Disease Prevention and Toxicology, DTU Food; K. Tyle, DK EPA / Chemicals

UBA, Germany, has initiated work to develop criteria to identify substances which are very persistent and very mobile (vPvM), and persistent, mobile and toxic (PvM) in the environment. The exposure poses and persistence criteria are a tool to screen water soluble substances and for ground water used as drinking water (human health concern). QSAR screenings using the free online Danish QSAR DB were performed on 2,372 mono-constituent organic substances. For persistency (P) algorithms as used for the persistency screening under PBT assessment was used. A new screening algorithm for very persistent substances (vP) was set up by adjusting the P screening algorithm. For mobile (M) and very mobile (vM) substances new screening algorithms were developed using the substance properties of water solubility (Sw) and the soil/sediment organic-water partition coefficient (log Koc) by equating log Koc and Sw values based on >64,000 substances. The pH-dependent octanol-water partition coefficient (log Dow) was used as an alternative value for substances which ionize at environmentally relevant pHe. For ecotoxicity, similar QSAR algorithms as used for the ecotoxicity screening under PBT assessments were used. In addition, new algorithms for predicting CMR properties from ongoing work on the updated Advisory Self-classification List (expected to be published by end of 2017 by the Danish EPA) were included to also take potential chronic mammalian toxicity into account. The selected QSAR based T-related algorithms were employed on top the screening algorithms for P and M properties as a screening tool for substances with a potential for mammalian and non-mammalian toxicity to wildlife species and human health. The results of the screenings identify the potentially vPvM and PBT substances currently registered under REACH in tonnages >10 tpa per manufacturer or importer. The screenings identify substances according to criteria proposed by UBA and the developed QSAR algorithms were applied on top the screening algorithms for P and M properties. The results provide input for current and future work with the concept of vPvMs/PMTs. The Danish QSAR DB contains 650,543 substances, of which 80,085 currently are pre-registered and/or registered under REACH. Future vPvM/PMT screenings can be refined to address specific substance groups of interest; substances registered after the last REACH registration deadline; or address future modifications, if relevant, in the proposed vPvM/PMT criteria.

WE073 Identifying PMT substances amongst REACH registered substances

H. Ary, NGO / Environmental Technology; S. Hale, Norwegian Geotechnical Institute; A. Striffler, denbares; D. Sätter, UBA / Section IV Chemicals; I. Schliebner, UBA; M. Neumann, German Environment Agency (UBA) / Section IV 2.3 Chemicals

The chemicals that have the greatest chances of appearing in drinking water are those that are mobile in the aquatic environment enough to enter drinking water sources and persistent enough to survive water treatment processes. Despite the great interest when discussing the screening algorithms relevant for the market, there is very little consideration as to how to identify or categorize which of them are persistent, mobile and toxic (PMT) and thereby pose a potential threat to drinking water. The list of REACH registered substances as of May 2017 was independently evaluated for their likelihood of being a PMT. The evaluation of persistent (P), very persistent (vP), or potentially persistent (i.e. Pscmn) was performed according to REACH guidelines. For mobility, a criteria of a measured (or estimated) log Koc six or less fluorinated carbons ("short chain"). Fluorotelomer-based products can be in either the polymeric or non-polymeric PFAS categories. Within the polymeric PFAS category, the fluorinated repellent products, including durable water repellents (DWRs), are found. These are normally side-chain fluorinated polymers typically applied in combination with other finishing auxiliaries. The side-chain polymeric fluorotelomer-based products perform exceptionally well and provide uniform film formation and critical properties on high-end performance garments, workwear, first responder gear and others. Within the non-polymeric PFAS category, fluorotelomer-based surface active agents (e.g. "fluorosurfactants") are used in complex multi-component formulations such as Cleaning Products, Paints, Coatings and Aquatic Film Forming Foams (AFFF). The non-polymeric fluorotelomer-based products provide superior surface wetting and leveling properties and are incorporated in Final Rinse Flex, High Performance Class B (i.e., hydrocarbon & polar solvent liquids) fires. The remarkable strength of the C-F bond provides products with superior resistance to extreme thermal, chemical and environmental conditions. While this unique stability makes these products ideal in many end-use applications, as well as in protecting people, equipment and property, it also makes them resistant to degradation and persistent in the environment. Each of the above fluorotelomer-based PFAS substances has a unique combination of properties and for ground water used as drinking water (human health concern). QSAR screenings using the free online Danish QSAR DB were performed on 2,372 mono-constituent organic substances. For persistency (P) algorithms as used for the persistency screening under PBT assessment was used. A new screening algorithm for very persistent substances (vP) was set up by adjusting the P screening algorithm. For mobile (M) and very mobile (vM) substances new screening algorithms were developed using the substance properties of water solubility (Sw) and the soil/sediment organic-water partition coefficient (log Koc) by equating log Koc and Sw values based on >64,000 substances. The pH-dependent octanol-water partition coefficient (log Dow) was used as an alternative value for substances which ionize at environmentally relevant pHe. For ecotoxicity, similar QSAR algorithms as used for the ecotoxicity screening under PBT assessments were used. In addition, new algorithms for predicting CMR properties from ongoing work on the updated Advisory Self-classification List (expected to be published by end of 2017 by the Danish EPA) were included to also take potential chronic mammalian toxicity into account. The selected QSAR based T-related algorithms were employed on top the screening algorithms for P and M properties as a screening tool for substances with a potential for mammalian and non-mammalian toxicity to wildlife species and human health. The results of the screenings identify the potentially vPvM and PBT substances currently registered under REACH in tonnages >10 tpa per manufacturer or importer. The screenings identify substances according to criteria proposed by UBA and the developed QSAR algorithms were already employed on top the screening algorithms for P and M properties. The results provide input for current and future work with the concept of vPvMs/PMTs. The Danish QSAR DB contains 650,543 substances, of which 80,085 currently are pre-registered and/or registered under REACH. Future vPvM/PMT screenings can be refined to address specific substance groups of interest; substances registered after the last REACH registration deadline; or address future modifications, if relevant, in the proposed vPvM/PMT criteria.

WE074 Recent Advances in Toxicology, Safer-Alternatives Assessment, Value-In-use and Best Practice Guidance of Short-Chain Fluorotelomer-based Products for AFFF, Textiles and Other End-Uses

S. Korzeniowski, BeachEdge Consulting; J. Bowman, Fluorocouncil Per- and polyfluoralkyl substances (PFAS) is a term that describes a wide and diverse array of chemistry containing fluorine and carbon. The focus of this poster presentation will be on the fluorotelomer-based products of the PFAS group with...
The Groundwater of Hydrogeological Sub-Region II at Buenos Aires province, is well characterized from a physico-chemical perspective. Until today is well established that fluoride and arsenic are the main concerns related with the potential use as source of drinking water. However, an ecosystemic perspective that focus on their invertebrate communities and the ecotoxicity potential is missing at least in this subregion. In this work we showed the preliminary results obtained after the sampling and analysis of ten on 20 total wells projected to be evaluated. This area is known as Junín Formation, which consists of sandy and silty sediments to silty loams of reddish brown to light brown color, very friable, with and scarce calcareous bodies of pedogenic origin. The Junín Formation of wind morphology constitutes an alternation of low elevations and depressions. Aeolian sediments, which belong to the Junín Formation (Aeolian Plateaus), normally do not exceed 5 m in thickness and usually have calcareous (coarse) levels. The alluvial and colluvial deposits (sandy silts, sands, gravels and blocks) have a reduced vertical and areal expression. The samples were characterized according their main anionic and cationic constituents, presence of glycophosphate and chloropyrifos, TOC, arsenic and fluoride. Also, cyto and genotoxicity of concentrated waters were studied by comet assay using coelomocytes of Eisenia fetida. Water quality was analyzed in combination with the dominant taxon of invertebrates founded. They were mainly composed by copepods, Acari, Collembola, Insecta, Oligochaeta, Nematoda. A preliminary biotic and eutrophic index were created to characterize each sampling well.

WE077 Chemical analysis, monitoring and toxicological evaluation of very polar compounds in drinking water and drinking water sources
R. Sjørs, KWR Watercycle Research Institute / Chemical Water Quality and Health; P. Kooij, KWR Watercycle Research Institute / K. Baken, KWR Watercycle Research Institute / CWG; A. Kolkman, KWR Watercycle Research Institute; P. de Voogt, University of Amsterdam / IBED
Very polar organic compounds are of special interest for drinking water utilities, since these substances tend to end up in drinking water. The distribution of persistent and mobile compounds in the urban water cycle is widespread since they can leach to groundwater and/or pass wastewater and drinking water treatment. Currently there is an analytical gap, a monitoring gap and a lack of toxicity data for persistent and mobile organic compounds (PMOC). We aimed to close these gaps by the implementation of a high-resolution MS-SPE screening method for very polar compounds and quaternary ammonium compounds and a target high-resolution MS screening. With these methods 45 samples from surface water, river, bank filtrate, groundwater and drinking water in The Netherlands and Flanders have been analysed. Detected compounds include known contaminants melamine, urutropon, metformin and guanylurea and newly detected compounds cytarabin, cyanuric acid and the antidepressant citalopram. Despite the high removal rates during drinking water treatment (70%), these compounds were found in drinking water. One compound is introduced during treatment: dichloroacetic acid. Most compounds and highest concentrations were detected in surface water and drinking water produced from surface water. The monitoring data of the very polar compounds gives insight into the seasonal variation of surface water quality. For the detected polar compounds human toxicological risk assessment is performed and results will be presented.

WE078 Beyond DEHP: High-molecular-weight phthalates and non-phthalate plasticizers in German Rivers
R. Nagota, Federal Environment Agency (UEA) / Water and Soil; J. Koschorreck, Umweltbundesamt
The phthalate plasticizer Di(2-ethylhexyl) phthalate (DEHP) is a well-documented ubiquitous contaminant and frequently regarded as the predominant plasticizer in the environment. The use of DEHP and other phthalates was banned in the EU because of their endocrine-disrupting activity. As a result, the production of these phthalates decreased significantly. In contrast, the global plasticizers demand is continuously growing. Market data show that high-molecular-weight phthalates are now extensively substituting DEHP together with various types of non-phthalate plasticizers. Previous investigations on plasticizers in the aquatic environment have largely focused on DEHP and selected low-molecular-weight phthalates. However, little is known about the presence of other phthalates and non-phthalate plasticizers. In contrast, this study focuses on the occurrence, fate and effects of these alternative plasticizers in the environment. The objective of this study was to obtain spatio-temporal trends for DEHP and its substitutes in freshwater systems. We analyzed suspended particulate matter samples (SPM) for the presence of 23 plasticizers, i.e. 17 phthalates and 6 non-phthalates. Samples from recent years indicate a fast appearance of new plasticizers like Diisononyl phthalate (DINP), Di(2-propylheptyl) phthalate (DPHP), as potential chemicals of emerging concern with increasing levels.

Wastewater effluents: How research can improve risk assessment and regulation (P)

WE079 Acute and chronic toxicity of Direct Blue 15 on microalgae and cladocerans: a comparative study
M. Hernández Zamora, Escuela Nacional de Ciencias Biologicas-I.P.N. / Laboratory of Experimental Hydrobiology; F. Martínez-Jerónimo, Escuela Nacional de Ciencias Biológicas-I.P.N. / Laboratory of Experimental Hydrobiology

Aquatic pollution resulting from industrial activities, especially textile, leather, food and agrochemicals, is a major concern. Dyeing process of fabrics produces approximately 90% of the total textile wastewaters, containing potential concentrations of residual dye. Colored wastewaters reduce light penetration in the water column, and affect photosynthesis of phytoplanktons. In addition, azo dyes are synthesized from carcinogenic compounds, such as benzidine; this can threat the aquatic biota. The environmental impact caused by the discharge of textile dyes effluents has been scarcely studied; therefore, our study was aimed at evaluating the toxic effect of the azo dye Direct blue 15 (DB15) on a primary producer (Pseudokirchneriella subcapitata) and on a primary consumer (Ceriodaphnia dubia). The microalga was exposed to 4, 8, 16, 32 and 64 mg L\(^{-1}\) DB15 (96 h, 25°C, and continuous illumination of 120 μmol m\(^{-2}\)s\(^{-1}\)); the effects of DB15 on photosynthetic pigment and macromolecules content (proteins, carbohydrates and lipids) were assessed. The acute toxic effects of DB15 dye in cladocerans were determined at 48 h; tested concentrations were 100, 200, 300, 400 and 500 mg L\(^{-1}\), at 25°C, 16 h photoperiod, with no food supply during the assays. In chronic toxicity tests C. dubia individuals were exposed to 5, 10, 15, 20 and 25 mg L\(^{-1}\) DB15 (7 days at 25°C, 16:8 h photoperiod, 1×10\(^{6}\) cell mL\(^{-1}\) of P. subcapitata as food). P. subcapitata was more sensitive to DB15 (50% 13.30 mg L\(^{-1}\)) than C. dubia (LC\(_{50}\), 450 mg L\(^{-1}\)). Chlorophyll-a and -b were significantly increased in the algae exposed to all the dye concentrations, comparing with the control, but carotenoids were significantly reduced in all the DB15 concentrations. Concentration of proteins, carbohydrates and lipids per cell in P. subcapitata exposed to all DB15 concentrations were significantly higher than that measured in the control. In the highest 15 DB15 concentrations, total progeny, number of released clutches, and reproductive were significantly decreased in C. regaudii; but age at first reproduction was significantly increased at 20 and 25 mg L\(^{-1}\) DB15. Results demonstrated that DB15 dye caused toxic effects of different magnitudes on aquatic biota (primary producer and primary consumer), for this reason, the azo dyes must be regulated to prevent environmental impacts caused by the discharge of textile dyes into waterbodies.

WE080 Integrated biomarker response calculation as a useful tool to assess the impact of pollutants on the health status of fish
S. Wilhelm, University of Tuebingen / Animal Physiological Ecology; S. Jacob, Universität Tübingen / Animal Physiological Ecology; M. Ziegler, R. Triebkorn, University of Tuebingen / Animal Physiological Ecology

Wastewater treatment plants (WWTPs) are considered as one of the major sources of micropollutants in the aquatic environment. Many compounds have been linked to toxic and endocrine effects in aquatic organisms. The present study examines the impact of three WWTPs situated on different streams in Southern Germany on the health status of fish. Two WWTP effluents were studied: one of them was equipped with an additional powdered activated carbon filter unit, which has been in operation since October 2013. In order to examine the effects of the different effluents on fish, one-year-old rainbow trout (Oncorhynchus mykiss) were exposed in cages upstream and downstream of each WWTP effluent. Furthermore, the impact of the WWTP upgrade with activated carbon was investigated by comparing results of casing exposures conducted prior and subsequent to the upgrade. Several biomarkers, including histopathological alterations, the formation of micronuclei and binuclei, changes in vitellogenin levels, induction of hepatic EROD activity, and changes in stress protein levels were examined, and the integrated biological responses (IBR) were calculated for the downstream exposure sites according to Sanchez et al. (2015), using the respective upstream site as a reference. IBR values for the conventional treatment plants (WWTP 1 and 2) differed slightly from each other, with WWTP 2 showing three to five times higher indices than WWTP 1. However, the highest IBR values were detected for male fish exposed downstream of the third WWTP prior to the upgrade with an activated carbon filter unit. After the installation of the additional treatment technology, a pronounced reduction of IBR indices than WWTP 2 was observed. These results confirmed that the biomarkers proved to be a suitable approach to assess the impact of WWTP effluents on the health status of fish. Furthermore, it was a helpful tool to reveal the advantages of WWTP upgrading with powdered activated carbon.

WE081 Application of eco-genotoxicological and microbiological parameters for the assessment of the quality of wastewater industrial use
S. Caciolli, Italian Institute of Health ISS / Department of Environmental and...
Pharmaceutical residues in sewage effluents pollutes the aquatic environment and may adversely affect fish populations. Conventional sewage treatment plants (STP) are not equipped to efficiently remove pharmaceuticals. Ozonation is emerging as a method to improve sewage treatment. Ozonation can however potentially create toxic by-products (OBr) that may have deleterious effects on fish. In this study we screened the concentrations of 103 pharmaceuticals and biological effects at a Swedish STP with a full scale parallel ozonation system. We investigated endocrine, reproductive and behavioral effects in fish and its progeny exposed to the conventional STP effluent. Furthermore, we sought to elucidate if any such effects were either abated or amplified by effluent ozonation (7 mg O₂ L⁻¹). We exposed zebrafish to dechlorinated tap water (n=3), STP effluent (n=3) and ozonated STP effluent (n=3). The fish were exposed during 21 days (12:12 day night cycle) in continuously replenished tanks (0.1 L/min, 25°C). During the last seven days, the fecundity (number of eggs produced per female) was measured and fertilized eggs were gathered from each replicate. The eggs were kept in our laboratory facilities and checked for mortality, malformations and locomotor activity at 6 days post fertilization. At the termination of the experiment, we recorded adult fish swimming activity and liver tissues was sampled for subsequent mRNA extraction and expression analysis. Results from the chemical screening showed that on average 77% of the screened pharmaceuticals were removed by ozone treatment. However, on the contrary to our assumptions, the biological effect screening revealed male liver VTG-2 gene expression, a marker of estrogenic endocrine disruption, was induced by the ozonated effluent. This indicates that ozonation possibly created estrogenic OBPs. Furthermore, the ozonated effluent contained 7-carboxylic fatty acids and a surprising compound in our list of possible genotoxic effect of sewage using the Micronucleus test (MN-test). The study results show a significant decrease in treated water samples of all microbiological parameters and the absence of E. coli. The ecotoxicological assays highlight a significant toxicity of the wastewater before the treatment while an evident decrease has been recorded after it. Sublethal effects for Danio rerio embryos and genotoxic effects for Vicia faba's micronucleus frequencies have been reported. Even though not yet conclusive, this approach can be considered a useful and promising tool in the reuse management of industrial wastewater and an initial support to the policy in this field.

WE084 Toxicity evaluation during secondary effluents treatment by UV/H₂O₂ using Eruca sativa and Artemia salina

L.Magalhaes, R.F. Dantas, Universidade de Campinas / Technology

When advanced oxidation processes are applied there is the concern of not forming more toxic compounds as a result of the oxidation and transformation of organic compounds. Therefore, the presence of contaminants of industrial origin may affect disinfection and form more toxic by-products. Thus, a detailed study of by-products formation and toxicity assessment during the oxidation process contributes to a more reliable and effective treatment. The formation and toxicity assessment during the oxidation process contributes to a more reliable and effective treatment. The major aim was to investigate the toxicity of secondary effluent treated with organic and a mixture in different ratios. A secondary effluent treatment by UV/H₂O₂, through tests with anegula seeds (Eruca sativa) and Artemia salina. Samples of secondary effluent from a pilot plant located at the School of Technology campus (UNICAMP, São Paulo, Brazil) were collected immediately after the secondary treatment and then they were treated and analyzed in triplicate. The biological reactor was a reactor: aseptic system (anaerobic). After collection, 200 mL of the sample was added to the reactor and stored at 4°C. Based on the preliminary tests it can be concluded that the secondary effluent treatment by UV/H₂O₂ is more toxic than the natural effluent, and treated effluent is not equipped to efficiently remove pharmaceuticals. Ozonation is emerging as a method to improve sewage treatment. Ozonation can however potentially create toxic by-products (OBr) that may have deleterious effects on fish. In this study we screened the concentrations of 103 pharmaceuticals and biological effects at a Swedish STP with a full scale parallel ozonation system. We investigated endocrine, reproductive and behavioral effects in fish and its progeny exposed to the conventional STP effluent. Furthermore, we sought to elucidate if any such effects were either abated or amplified by effluent ozonation (7 mg O₂ L⁻¹). We exposed zebrafish to dechlorinated tap water (n=3), STP effluent (n=3) and ozonated STP effluent (n=3). The fish were exposed during 21 days (12:12 day night cycle) in continuously replenished tanks (0.1 L/min, 25°C). During the last seven days, the fecundity (number of eggs produced per female) was measured and fertilized eggs were gathered from each replicate. The eggs were kept in our laboratory facilities and checked for mortality, malformations and locomotor activity at 6 days post fertilization. At the termination of the experiment, we recorded adult fish swimming activity and liver tissues was sampled for subsequent mRNA extraction and expression analysis. Results from the chemical screening showed that on average 77% of the screened pharmaceuticals were removed by ozone treatment. However, on the contrary to our assumptions, the biological effect screening revealed male liver VTG-2 gene expression, a marker of estrogenic endocrine disruption, was induced by the ozonated effluent. This indicates that ozonation possibly created estrogenic OBPs. Furthermore, the ozonated effluent contained 7-carboxylic fatty acids and a surprising compound in our list of possible genotoxic effect of sewage using the Micronucleus test (MN-test). The study results show a significant decrease in treated water samples of all microbiological parameters and the absence of E. coli. The ecotoxicological assays highlight a significant toxicity of the wastewater before the treatment while an evident decrease has been recorded after it. Sublethal effects for Danio rerio embryos and genotoxic effects for Vicia faba's micronucleus frequencies have been reported. Even though not yet conclusive, this approach can be considered a useful and promising tool in the reuse management of industrial wastewater and an initial support to the policy in this field.

WE083 Comparative effects of the azo dye Congo Red on the green microalgae Ankistrodesmus falcatus and Scenedesmus incrassatus

A.A. Chávez-Vargas, Instituto Politécnico Nacional. Escuela Nacional de Ciencias Biológicas; M. Hernández Zamora, Escuela Nacional de Ciencias Biológicas-IPN / Laboratory of Experimental Hydrobiology; F. Martínez-Jerónimo, Escuela Nacional de Ciencias Biológicas-IPN / Laboratory of Experimental Hydrobiology

Azo dyes are widely used as an ingredient and as a necessary element for production. The re-use of treated wastewater and an initial treatment by UV/H₂O₂. However, the few studies that reported. Even though not yet conclusive, this approach can be considered a useful and promising tool in the reuse management of industrial wastewater and an initial support to the policy in this field.

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Azo dyes are widely used as an ingredient and as a necessary element for production. The re-use of treated wastewater and an initial treatment by UV/H₂O₂. However, the few studies that reported. Even though not yet conclusive, this approach can be considered a useful and promising tool in the reuse management of industrial wastewater and an initial support to the policy in this field.
occurrence of APIs. Hitherto, the published investigations provided evidence of APIs occurrence discharges from pharmaceutical factories also contributes to the occurrence of elevated levels of APIs. Also, the presence in this area of industrial wastewater facilities (WWT). The otherwise is the main source of APIs to the environment and identified heavily pharmac compounds. Thus, the scientific attention has increased to account compounds have been investigated. However, a crucial part of the occurring compounds equivalents is formed by androgen receptor inhibiting or activating compounds. Therefore, their strong lipophilicity, the main part of these compounds accumulates in sediments in suspension to reduce endocrine-disrupting MPs is the implementation of an additional treatment step like ozonation. Within the DemO/AC Project, the WWTP in the catchment area of the river Wurm in Aachen Germany will be equipped with a large-scale ozonation. It is unknown how the concentrations of (anti-)androgens in sediments will be altered by this new treatment step. Up to now, controversial results were published regarding the elimination of (anti-)androgens by ozonation in effluents. Furthermore, sediments were rarely studied. To fill this scientific gap, this study will evaluate the status quo of (anti-)androgenic potentials in sediments and samples from the WWTP before the implementation of the ozonation at the WWTP in 2018. Investigation of samples from a rain spillway basin was conducted to measure the potential endocrine impacts of pollutants with high endocrine-disrupting capacities. Ozonation is an example of such high-endocrine-disrupting pollutants. To gain more information. Assessment of (anti-)androgenic activity was performed by testing sample extracts using the (anti-)AR-CALUX® assay. These studies will be conducted associated to the DemO/AC Project as part of an exploratory study. First results revealed an anti-androgenic potential as well as cytotoxicity in the highest concentrations of the samples. The full depiction of the (anti-)androgenic potential in the catchment area of the Wurm will be available at the time of the conference.

Processes underlying the environmental fate of pharmaceuticals in the Nairobi River Basin “impact zone”: implication for environmental risk assessment

S. Bagins, M. Fitzsimons, A. Tappin, Plymouth University; J. Snape, AstraZeneca UK Ltd / AstraZeneca Global Environment; A. Gachanja, Jomo Kenyatta University of Agriculture and Technology / Chemistry; S. Comber, Plymouth University / Environmental Science

Recent investigations have highlighted the widespread occurrence of active pharmaceutical ingredients (APIs) in African water bodies. Wastewater (treated or otherwise) is the main source of APIs to the environment and identified heavily contaminated areas have been ascribed to the poor African wastewater treatment facilities (WWT). The formation of so called “impact zones” is severe in urban areas characterized by informal settlements with little in the way of wastewater treatment. The Nairobi river system in Kenya is an example of such contaminated areas. The wastewater generated from the city’s informal settlements and the insufficient WWT is directly discharged in the Nairobi River basin leading to a large-scale “impact zone” characterized by occurrence of high levels of ammonia, biochemical oxygen demand and low dissolved oxygen and commensurately elevated levels of APIs. Also, the presence in this area of industrial wastewater discharges from pharmaceutical factories also contributes to the occurrence of APIs. Hitherto, the published investigations provided evidence of APIs occurrence at concerning concentrations, but little is known about the processes underlying the E-fate of such contaminants. Processes such as distribution to suspended solids, colloids and dissolved organic matter, the quality of these sorbents, and the ability of the biodegrading bacteriological community to adapt to and degrade a contaminant are key in determining its E-fate. The impact zone generated by sewage and industrial wastewater together with the local natural sorbents abundance influences the APIs distribution and E-fate. Data will be presented on sorbent concentration and quality related to distribution processes of APIs in the

Impact zone and the individualization of eventual bacteriological community shifts as an effect of the direct discharge of untreated wastewater loaded with APIs. In addition, since preliminary studies on the biodegradation of the antiretroviral nevirapine, commonly used in Africa, has showed persistency (similarly to studies on the antiepileptic carbamazepine in Western countries) the occurrence of nevirapine will be studied to test its suitability as indicator of sewage pollution in African river bodies. The implementation of this study contributes to the development of a methodology for the determination of the impact zone spatial boundaries and a dedicated environmental risk assessment approach for APIs in the impact zone.

Occurrence of pharmaceuticals, metabolites and transformation products from combined sewer overflows in London measured by high resolution targeted, suspect screening and untargeted chemical analysis

J. Barron, Kings College London / Analytical and Environmental Science; K. Munro, Kings College London; T.H. Miller, Kings College London / Analytical and Environmental Sciences; D.A. Cowan, Kings College London / Drug Control Centre; C. Martins, Thermofisher Scientific; I. Perez-Toro, University Department of Biological Centre for Environmental and Marine Studies CESAM Combined sewer overflows (CSOs) are controlled releases of raw, untreated wastewater to a river during times of heavy rainfall to avoid back-flushing of buildings and streets. The impact of CSOs on a river catchment with respect to pharmaceutical residues is not well understood. In London, CSOs occur ~12 times per week as its Victorian sewage network struggles to cope. Here, a temporal study of the River Thames is presented to identify CSO-related occurrence of pharmaceuticals, including metabolites and transformation products. Daily samples of river water, influent and effluent wastewater were analysed using a validated method involving solid phase extraction (SPE) and liquid chromatography and high resolution accurate mass spectrometry (LC-HRMS). The work was divided into four aspects: (a) the identification of CSO markers based on the detection of 30 pharmaceutical/metabolite occurrences in influent and effluent wastewater; (b) determination of CSO markers in receiving river water over a six-week period; (c) suspect screening to identify metabolites/transformation products; and (d) classification of samples using untargeted data analysis. By differentiating influent and effluent wastewater CSOs were successfully identified including caffeine, bezafibrate, bezoylecogonine and furosemide which were present only in influent at relatively high/consistent concentrations. Following this, targeted analysis of the River Thames samples revealed that CSO marker concentration increased mainly during wet periods where the tide was low. A further 14 compounds were also determined to observe any ‘dilution effects’ related to CSO event occurrence. The potential occurrence of known metabolites/transformation products is also presented for a selection of compounds via machine learning prediction of LC retention times and mining of HRMS data [1]. Finally, untargeted analysis revealed that river samples could be differentiated based on climate and/or tide height using principal component analysis and volcano plots. The use of several different modes of data analysis proved useful in the complex nature of understanding of complex occurrence data potentially influenced by timed CSO events. [1] K Munro, TH Miller, CPB Martins, AM Edge, DA Cowan, LP Barron, J. Chromatogr. A, 1396 (2015) 34-44

Occurrence, fate and bioactivity of pesticides in wastewater

V.V. Yargeau, McGill University / Chemical Engineering; P. Westlund, D. Nasuhoğlu, S. Isazadeh, McGill University

Unlike for contaminants of emerging concern (CECs), data available for the occurrence, fate and bioactivity of pesticides (herbicides, fungicides, and insecticides) in wastewater treatment plants (WWTPs) is limited. Our research showed that of the 18 compounds investigated only imidacloprid, was not detected at the three WWTPs included in the study, confirming that municipal wastewater discharges contribute to the presence of pesticides in the aquatic environment. Using a suite of bioassays (high-throughput bioluminescence assay using the target species Vibrio fischeri, yeast estrogenic screen (YES) and yeast androgenic screen (YAS)) and chemical analysis, we identified whether water samples treated using secondary treatment or ozonation was investigated. It was found that of the 12 pesticides showed either antiestrogenic or antiandrogenic activity and 7 compounds showed pleiotropic effects. This study was first to confirm endocrine activities based on yeast-based assays of recent neonicotinoids. The use of extended time points for the Vibrio fischeri, beyond the traditional 30 minutes, highlighted the bioavailability for some compounds was underestimated using only the acute test. Using a structure-activity relationship approach similar to the one used in hazard assessments, the relationship between toxicity and key physiochemical properties of the pesticides was investigated and trends were identified. This work also provided new knowledge on the removal of some fungicides (climbazole, myclobutanil and tebuconazole) by ozonation and demonstrated the recalcitrant nature of pesticides during ozonation. This study is one of the first to investigate androgenic activity during the ozonation of a mixture of pesticides and an increased impact was reported. These findings further demonstrate the importance of combining bioanalytical tools to analytical chemistry in the evaluation of wastewater quality
metal excess and concentration in the sediment cores from the Adige prodelta down to the Gargano, which has been mainly related to the environmental regulations enforced by governments. Finally, the main transfer process of trace metals from coastal waters to the open sea is attributed to the cascading of the North Adriatic Dense Water (NADW) in deep sea areas of the southern Adriatic, which would be able to quickly transfer suspended sediments (and, therefore, particle-binding contaminants) during episodic events and supports the inference that this region may act as the final repository for contaminants within the Adriatic Sea.

**WE902 Photocatalysis as a potential pre-treatment process to reduce organic pesticide entries**

F. Schaffert, Inst. for Environmental Sciences / Institute for Environmental Sciences; R. Rosenfeldt, University of Koblenz-Landau; Institute for Environmental Sciences / Institute for Environmental Sciences; P. Garcia Munoz, N. Keller, D. Robert, V. Keller-Spitzer, Universität von Strassburg / Institut de Chimie et Procédés pour l’Énergie, l’Environnement , et la Santé (ICPEES), CNRS; B. Altmaier, M. Twertek, State Education and Research Center of Viticulture, Horticuture and Rural Development / Institute of Plant Protection; S. Liefiaard, Universitat Koblenz-Landau / Institute for Environmental Sciences; R. Schultz, University of Koblenz-Landau / Institute for Environmental Sciences

For protecting their crops many wine growers apply plant protection products (PPPs), which may accidentally end up in the aquatic environment e.g. after being washed off from agricultural machinery (AM). Once there, PPPs can negatively impact aquatic life which can be caused already by UV light. This is a problem related difference in the degradation potential of TiO2-based photocatalysts, treated and untreated PPPs were analyzed for remaining PPP concentrations and major metabolites before and after a combined TiO2 × UV treatment. Therefore, UV-visible absorbance spectroscopy, Total Organic Carbon (TOC) measurement and liquid chromatography was used. Further, to assess for the phytotoxicity of PPPs, reductions of photosynthetic activity and acute toxicity were conducted. In detail, Daphnia magna was exposed for 48 h to untreated PPPs according to the OECD guideline 202. Gained immobility data was statistically analyzed to detect significant differences among photocatalytic treatments. Preliminary results of both, analytical and ecotoxicological investigations, show the suitability of TiO2 to reduce PPP concentrations and associated acute toxicity in water within minutes by UV light. Further studies considering the related difference in the degradation potential of TiO2 for the selected PPPs was observed. However, for a final statement whether TiO2 can be used for an efficient photocatalytic pre-treatment of wash water from AM, further studies considering different environmental conditions – potentially hindering this process – are urgently needed.

**WE903 Study of the efficiency of removal of organic load and generation of energy through a bioelectrochemical system coupled to a constructed wetland**


The Trinational Upper River Area is known where wine growing is one major form of agriculture. To evaluate product dependent efficiencies of TiO2 based photocatalysis, treated and untreated PPPs were analyzed for remaining PPP concentrations and major metabolites before and after a combined TiO2 × UV treatment. Therefore, UV-visible absorbance spectroscopy, Total Organic Carbon (TOC) measurement and liquid chromatography was used. Further, to assess for the phytotoxicity of PPPs, reductions of photosynthetic activity and acute toxicity were conducted. In detail, Daphnia magna was exposed for 48 h to untreated PPPs according to the OECD guideline 202. Gained immobility data was statistically analyzed to detect significant differences among photocatalytic treatments. Preliminary results of both, analytical and ecotoxicological investigations, show the suitability of TiO2 to reduce PPP concentrations and associated acute toxicity in water within minutes by UV light. Further studies considering the related difference in the degradation potential of TiO2 for the selected PPPs was observed. However, for a final statement whether TiO2 can be used for an efficient photocatalytic pre-treatment of wash water from AM, further studies considering different environmental conditions – potentially hindering this process – are urgently needed.

**WE901 Patterns of natural and human-made interacting processes on source, transport and fate of trace metals in the Adriatic Sea basin**

M. Rocha, University of Bologna; T. Combi, Istituto Geografico Nazionale, Università di Bologna / Department of Environment and Development / Institute of Plant Protection; J. Turek, University of South Bohemia in Ceske Budejovice / Faculty of Fisheries and Protection of Waters; J. Turek, University of South Bohemia in Ceske Budejovice / Faculty of Fishery and Protection of Waters; J. Stárk, University of South Bohemia in Ceske Budejovice / Laboratory of Environmental Chemistry and Biochemistry; K. Grabicova, University of South Bohemia in Ceske Budejovice / Faculty of Fisheries and Protection of Waters, LECHB; T. Randak, University of South Bohemia in Ceske Budejovice / Laboratory of Environmental Chemistry and Biochemistry

Within our experiment, the fate of fourteen PFASs was studied in an ecosystem of a small stream affected by STP’s effluent. The unique field experiment design was carried out to allow long-term study focused on bioaccumulation of PFASs in indicator organisms and their ability of adaptation to the polluted environment. Two hundred brown trouts (Salmo trutta) originating from clean site within the same stream were tagged and stocked downstream the source of pollution. Those fish were recaptured after one, three, and six months they spent in the environment affected by the effluent of that local STP. Besides the fish stocked into the polluted locality from the clean site, also fish originally inhabiting the downstream locality and macroinvertebrates from both sites were sampled and analysed. Passive sampling approach using polar organic chemical integrative samplers (POCIS) was applied to determine occurrence of PFAS in water soluble fraction over the course of the experiment instead of conventional grab water samples. Twelve of the fourteen target PFASs were found in concentration above the LOQ in at least one of the examined localities. The lowest concentration from downstream locality while only three were present in samples from clean site. The compound pattern varied significantly between fish species of macroinvertebrates, and POCIS indicating several exposure pathways leading to bioaccumulation of PFASs in fish body. Concerning the accumulation of PFASs in fish, the highest concentrations were found in the liver of individuals sampled after three months of exposure. These concentrations rapidly decreased after six months although there was no significant change in occurrence of PFASs in water during the experiment. Such finding can be linked to both increase of water temperature leading to higher enzymatic activity and adaptation of studied fish to the polluted environment. Based on our results we also suggest that the process of adaptation might be related to the gender of fish as we found significantly higher concentration of PFASs in males instead of females. Acknowledgements: The study was financially supported by the Ministry of Education, Youth and Sports of the Czech Republic - projects “CENAKVA” (No. CZ.1.05/2.1.00/01.0024) and “CENAKVA II” (No. LO1205 under the NPU I program) and by the Ministry of Agriculture of the Czech Republic (NAZV “KUS” No. Q15530120).

**WE980 Fate of perfluoroalkyl substances within a small stream food web affected by sewage effluent**

D. Cerveny, University of South Bohemia in Ceske Budejovice / Laboratory of Environmental Chemistry and Biochemistry; R. Grabicova, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrogenooses; G. Fedorova, University of South Bohemia in Ceske Budejovice / Laboratory of Environmental Chemistry and Biochemistry; K. Grabicova, University of South Bohemia in Ceske Budejovice / Faculty of Fisheries and Protection of Waters, LECHB; T. Randak, University of South Bohemia in Ceske Budejovice / Laboratory of Environmental Chemistry and Biochemistry

The Adriatic Sea has been under intensive influences of human activity mainly due to long historical trends of sedimentary trace metals (Zn, Pb, Cu, Cr and Ni) and their accumulation in the western Adriatic Sea. The anthropogenic sedimentary metal load can be recognized in sediment cores from the northern Adriatic and dated cores from the Trinational Upper River Area, a region where wine growing is one major form of agriculture. To achieve a Good Environmental Status until 2020 in European water bodies, spatial and temporal frequency (e.g., 5 years), suitable to point out possible changes in metal accumulation in the western Adriatic Sea. The anthropogenic signal of Pb and Zn can be recognized in sediment cores from the northern down to the Gargano Peninsula, ~500 km away from the metal sources, with a delay of ~10 years. In line with many systems around the world, we observed a recent decrease in trace metal excess and concentration in the sediment cores from the Adige prodelta down to the Gargano, which has been mainly related to the environmental regulations enforced by governments. Finally, the main transfer process of trace metals from coastal waters to the open sea is attributed to the cascading of the North Adriatic Dense Water (NADW) in deep sea areas of the southern Adriatic, which would be able to quickly transfer suspended sediments (and, therefore, particle-binding contaminants) during episodic events and supports the inference that this region may act as the final repository for contaminants within the Adriatic Sea.
COD measurement was performed weekly on the influent and effluent of both systems. After 40 days in operation, the systems showed voltage average values of 673 and 580 mV, maximum current densities of 20.8 and 37.5 mA/m² and COD removal of 38.5 and 36.71% for effluents AZ and AP, respectively. A significant increase in the current density was observed in the measurements taken after 13:00 h, which shows an effect of temperature on the generation of voltage and therefore current flow in the system. The results obtained represent a sustainable option for the generation of energy from domestic wastes for secondary effluents, which would not only improve the quality of the water before being discharged to the receiving bodies but also take advantage of the high concentrations of nutrients contained in these wastes.

WE094 Adsorption of Crystal Violet from Quaternary Basic Dye Mixture onto A Sawdust-Based Adsorbent

A. A. Gwia, Cape Peninsula University of Technology / Department of Pure and Applied Chemistry; K. A. Abdulsalum, Adeleke University, Ede. Nigeria / I Department of Basic Sciences, Chemistry Unit; F. Wewers, Cape Peninsula University of Technology / Chemistry; I. A. Bello, Ladoko Akintola University of Technology / Department of Pure and Applied Chemistry

Wastewaters from textile and other dye-using industries usually contain more than one dye. In such an aqueous matrix therefore, the adsorptive characteristics of a dye species are likely to be affected by the presence of the other dye species in the medium. The removal of crystal violet from aqueous solution by sulphuric acid-activated sawdust (SA), bentonite, and activated charcoal of malachite green, methylene blue and rhodamine B on its adsorption from binary, ternary, and quaternary dye systems were studied. The combined effect of mixture components and process parameters on the adsorption was studied and optimized using response surface methodology. The adsorbent was characterized and the experimental data obtained were fitted to different kinetics and isotherm models. The experimental results were analyzed with the analysis of variance (ANOVA) statistical concept. The optimum contact time, pH, adsorbent dose and temperature were found to be 275.10 min, 9.94, 0.99 g and 60 °C respectively for the maximum decolorisation of 68.39% at an initial concentration of 50 mg/L CV (97.2%). A linear model was obtained for the decolorization process through this design. The experimental values obtained were in good agreement with predicted values, and the model developed was highly significant, with correlation coefficient of 0.985. The adsorption in all the dye systems investigated followed Freundlich isotherm, and the maximum monolayer adsorption capacity was between 18.87 - 24.39 mg/g, depending on the composition of the adsorbate matrix. The adsorption kinetics was well described by the pseudo-second order model (R² > 0.95). All the eight adsorbate systems investigated were endothermic (ΔH positive; 35.30 to 43.66 KJ mol⁻¹), thermodynamically feasible (ΔG is > -6.3 KJ mol⁻¹) and had increased entropy.

WE095 Diurnal patterns and removal of selected elements in two Norwegian wastewater treatment plants with primary treatment

I. B. Reitaa, SINTEF Ocean; L. D. Sund, Norwegian Institute of Water Research; S. M. Nejad, SINTEF Materials and Chemistry; A. Booth, SINTEF Ocean / Environmental Technology

Discharges from wastewater treatment plants (WWTPs) are a source for pollutants to the environment. Here we studied influent patterns and removal of selected elements in two Norwegian WWTPs (Ladehammeren (LARA) and Høvringen (HØRA)) in Trondheim, Norway. Both WWTPs have significant industrial loading to the environment. Here we studied influent patterns and removal of selected elements, and were highest for Al (86%), P (74%) and Cu (57%) in LARA, whereas for Fe and Pb both were lower. Of the selected elements, the strongest correlations observed for P, S and Cu (R²>0.9). Correlations with TSS were less pronounced in LARA, and were weakest for Pb, Fe and Cu (R²<0.6), which can be potentially attributed to the higher industrial loading contributions in LARA.

Enrichment factors were high for P-Cu-Zn-Cd-As, and were still above 10 for Cr and Ni in biosolids, indicating anthropogenic sources for these elements. Several elements also occurred as nano- and micron-sized particles.

WE096 Rapid detection of E. coli in wastewater effluent and impact of effluent discharge on riparian invertebrate diversity

P. M. Mosolloane, University of the Free State / Zoology and Entomology

Effluent samples from wastewater treatment plants are expected, due to the treatment processes, to have lower concentrations of toxicants and pathogens than the influent. As such, they are expected to have a lesser impact on the environment than the influent. The aim of this study was to seasonally assess the efficiency of Phuket’s wastewater treatment plant in removing pathogens (E. coli) from its effluent and to determine the impacts of that effluent on invertebrate diversity along the riparian zone of the receiving watershed. Loop mediated isothermal amplification technique was used to screen for the presence of E. coli in effluent samples. There was negative identification of E. coli in the samples collected. Impacts of effluent on invertebrates will be determined by analysing the changes in population dynamics of the invertebrates found in the riparian zone, above and below discharge point of the Wastewater Treatment Plant. At least, 13 morph species of eight insect families have been identified. Taxon diversity will be calculated using the Simpson-Yule Index, from where significant difference analysis would be calculated for environmental variable, species abundances and diversity data. More screening for the presence of E. coli will determine the efficiency of Phuket’s wastewater treatment plant in removing E. coli from its effluent. Further identification and presence or absence of invertebrates in the sampled riparian zone will determine if E. coli effluents have any impacts on invertebrate diversity.

WE097 The Demo3AC-project: Chemical and ecotoxicological investigations of the wastewater treatment plant Aachen

S. Schiew, Institute of Environmental Research-RWTH Aachen / Department of Ecosystem Analysis; Y. Müller, RWTH Aachen University / Institute for Environmental Research; A. Shulaikevich, Institute for Environmental Research (RWTH) / Aachen University / Institute for Environmental Research; S. Könenmann, Institute for Environmental Research RWTH; S. Oster, RWTH Aachen University, Institute for Environmental Research; K. Klaer, R. Dolny, Institut of Environmental Engineering, RWTH Aachen; S. Classen, Research Institute gaiac; M. Hammers-Wirtz, gaiac / Research Institute for Ecosystem Analysis and Assessment Aachen; I. Bröckel, Effel-Rur Waterboard; J. Finnekempe, RWTH Aachen University / Institute of Environmental Research; H. Hollert, RWTH Aachen University / Institute for Environmental Research

Microplutants (MPs) in municipal wastewater, like pharmaceuticals, are not sufficiently removed by conventional cleaning methods in wastewater treatment plants (WWTPs). As a consequence, complex mixtures of MPs discharged into the receiving streams and may cause various effects on the aquatic biota. To decrease the exposure of MPs into the environment, a full-scale ozonation is implemented into the WWTP Aachen Soers, Germany within the Demo3AC-project. A crucial part of this project is the evaluation of the ecological and chemical state of the receiving stream, the River Wurm. This study focuses on the status quo of this river. To assess the impact of MPs, water samples were taken at 3 treatment steps within the WWTP and at 4 sampling sites (upstream and downstream the WWTP) along the River Wurm. In total, 52 substances were identified in the WWTP influent, effluent and to determine the impact of that effluent on invertebrate diversity. This study focuses on the status quo of this river. To assess the impact of MPs, water samples were taken at 3 treatment steps within the WWTP and at 4 sampling sites (upstream and downstream the WWTP) along the River Wurm. In total, 52 substances were identified in the WWTP influent, effluent and to determine the impact of that effluent on invertebrate diversity.
many sewage overflows into surface water are present. Sediment located 250 m before and after the overflow needs to be discarded and burnt after dredging while ‘normal’ sediment can be reused as soil. Discard and burning is expensive for water boards, besides the fact that it costs a lot of energy and causes air pollution due to transportation, which is not sustainable. Also it causes a loss of raw materials. The water board Noordzeeldiavert has started a pilot for reusing sewage overflow dredgings as a new construction material for agriculture. For this purpose two depots have been set up: one with reference sediment and one with overflow sediment. During one year the concentrations of pharmaceuticals and pathogens will be monitored as well as antibiotic resistance and endocrine disruption. The basis of the project is the hypothesis that pathogens will be killed during the process of drying and pharmaceuticals will be (biologically) degraded which may make this process workable in the future. In June 2017 the sediments were sampled and analysed. In October dredging was performed and the pilots have been set up. The first monitoring round was performed one week after set up. In each monitoring round chemical analyses are performed on pharmaceuticals. Pathogens are identified by both culturing methods and Next Generation Sequencing (NGS), combined with viable PCR analyses to quantify specific pathogens that have been identified by NGS. Antibiotic resistance will be monitored by means of ESBL (extended Spectrum Beta-Lactamase) measurements. Endocrine disruption will be monitored by means of ER-Calux tests. In the presentation the background of the project will be sketched, then the results of the monitoring up till May 2018 will be presented. Also preliminary conclusions will be drawn and an outlook for future possibilities will be given as well as the meaning of the project for other water boards.

WE099 Assessing wastewater processes at oil refinery industry in Kazakhstan

I. Radelyuk, Lund University / Department of Building and Environmental Technology, K. Tussupova, LTH, Lund University / Department of Building and Environmental Technology.

This paper presents the first attempt to assess the wastewater treatment processes at the oil refinery sector in Kazakhstan and evaluate to what extent these processes follow international and national regulations regarding industrial waste water treatment. The assessment was performed considering wastewater discharge from refinery processes at three factories in the country. While Kazakhstan environmental regulations promote the polluter pay principle and follow WHO guidelines, oil refinery factories in Kazakhstan still exceed the permissible concentration of pollutants in discharged wastewater. The national regulation allows discharge of wastewater to natural or artificial ponds by not exceeding the pollutant concentrations already existing in the pond. Therefore, the factories use pond treatment as a straightforward method of discharge. Consequently, allowing discharge of high concentration of pollutants (total petroleum hydrocarbons (TPH) exceeds concentration by 30-80 times, ammonia (NH\textsubscript{3}) by 25 times, total dissolved solids (TDS) by 6 times, biochemical oxygen demand (BOD) by 6 times and surfactants by 5 times) to pond. The reason for the initial high pond concentration is a result of a time gap between the start of pollution discharge by the factories and start of the environmental regulations. This leads to no incentive to treat wastewater in an efficient way. Additionally, the national law lacks regulations regarding detailed methodology to assess the pollutant substances in the discharged wastewater. Thus, the assessment by environmental authorities for each oil refinery is negotiated separately between the factory and the governmental body, giving the factory a strong position to define the parameters assessing the wastewater. As such, only a small number of new data is provided for assessment of pollutants, consequently allowing discharge of high concentration of pollutants from the factories to pond. TPH concentration in wastewater is often exceeded at each factory and there is no analysis done for different hydrocarbon fraction.

Consequently, it is strongly recommended to provide a unified and transparent assessment process for each oil refinery industry in Kazakhstan in order to provide a strong position to define the parameters assessing the wastewater. As such, the national law lacks regulations regarding industrial waste water treatment processes at oil refinery industry in Kazakhstan.

Antibiotics and Antibiotic Resistance in the Environment: Fate and Ecological Effects, Resistance Development and Implications for Human Health (P)

WE100 Accumulation of Enrofloxacin in the sea lettuce Ulva lactuca

J. Rosa, University of Coimbra / Department of Life Sciences; S. Leston, CFE-Center For Functional Ecology / Department of Life Sciences University of Coimbra; A. Freitas, J. Barbosa, INIAV - Instituto Nacional de Investigação Agrária e Veterinária; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLEiria; M. Pardal, CFE-Center For Functional Ecology / Department of Life Sciences University of Coimbra; F. Ramos, Faculty of Pharmacy University of Coimbra

The demand for food products is pushing aquaculture to increase its production throughout the world. The increase in production can lead to negative effects since much more fish are growing in much smaller places. Aquaculture is still heavily associated with the frequent use of chemical compounds in water, either to treat or prevent disease outbreaks in culture ponds. Integrated multivitrophic aquaculture systems (IMTAs) can be a suitable approach to fish production, since one can have several species with different trophic levels growing together, where each species has its own economical value. Macrocystis can be used in such systems, usually at the exit point of the ponds, acting as biofilters and reducing the nutrient loading released to the environment. Contaminants such as antibiotics used in aquaculture can bioaccumulate in these organisms, passing to higher trophic levels. More recently, with the inclusion of macroalgae in human diets not only in Asia but also in other regions, we can ultimately ingest high levels of pharmaceutical contaminants, which are not eliminated the same way as other fish products. Exposure tests were performed with the macroalgae Ulva lactuca in order to evaluate the effects of Enrofloxacin in growth. Antibiotic concentrations were measured in seawater and macroalgae discs at several sampling points, after immersion in an Enrofloxacin bath at two different concentrations. These results can help comprehend how IMTA systems can be used in order to prevent contamination with antibiotics. As biofilters, these organisms are located at the exit point of fishponds or near cages, potentially accumulating pharmaceuticals.

WE101 Antibiotic resistance genes in manure, stored manure and soil after manure application

M. Virta, K. Pärmänen, University of Helsinki; R.D. Stedfeld, J.M. Tiedje, Michigan State University / Center for Microbial Ecology Department of Civil and Environmental Engineering; J. Muurinen, University of Helsinki / Food and Environmental Sciences

Production animal farms are proposed to act as reservoirs where genetic material from manure can be transferred to other species. In this way, a transfer mechanism can be created to move resistance genes from animal to human or to other animal-associated bacteria including zoonotic pathogens. In the present study we followed two swine and two dairy farms and quantified ARGs and MGEs with 363 primer pairs using a high-throughput qPCR array. Samples were taken from fresh manure, stored manure, unfertilized soil, soil fertilized with manure, and tile drainage water from ditch, which was sampled before and after application. We aimed to answer the following questions: do ARGs disseminate to the environment (field soil and surface waters), are ARGs enriched in stored manure, and are ARG abundances elevated in soils at crop harvesting time. For evaluating the ARG mobility potential, genes related to MGEs were also quantified. DNA was isolated from the soil and manure samples with the PowerSoil DNA Isolation Kit (MO BIO Laboratories). Quantitative PCR reactions were conducted using WagerGen SmartChip Real-Time PCR system. The ΔCt values, ΔΔCt values, relative gene abundances (R), and fold changes (FC) were calculated with R version 3.2.3 and RStudio Version 0.98. In total 182 out of 363 ARG and MGE qPCR assays were positive in one or more samples. Out of the positive assays, 161 targeted ARGs and 21 MGEs. Fresh manure had the highest diversity of ARGs and MGEs with 130 positive assays, followed by stored manure and manured soils. The number of positive assays decreased in fertilized soil between the 2 and the 6 week sampling points. Only 29 assays were positive in unfertilized soil samples. Manure had the highest relative abundances of ARGs, and these manure-associated ARGs were not detected in unfertilized soil or ditch water sampled before fertilization. Likewise, ARGs abundant in unfertilized soil or in ditch water were not abundant or even detected in manure. After fertilization, the manure-associated ARGs and MGEs were present in soil, hence a consequence of fertilization. However, the abundance and number of these ARGs and MGEs clearly decreased from fertilized soil to fertilized soil samples taken 2 and 6 weeks after manure application. During manure storage the relative abundance increased more than 4-fold for 41 genes and more than 2-fold for 62 genes. The highest increase (up to 65-fold) was observed in tetracycline-resistance genes, followed by sulphonamide and aminoglycoside resistance genes with up to 45-fold and 41-fold increases.

WE102 Bioaccumulation, biochemical responses and gene expression in the marine clam Scrobicularia plana exposed to a pharmaceutical mixture at sub-lethal concentrations

C. Trombini, CSIC Spanish National Research Council ICMAN / ECOLOGY AND COASTAL MANAGEMENT; M. Hampel, INMAR University of Cadiz; J. Kazakova, R. Fernandez-Torres, M. Bello-López, University of Seville; J. Blasco Moreno, CSIC Spanish National Research Council ICMAN / ECOLOGY AND COASTAL MANAGEMENT; M. Virta, University of Helsinki

Pharmaceuticals are pollutants of potential concern in the aquatic environment where they are commonly introduced as complex mixtures as a result of incomplete waste water treatment plant removal processes and improper disposal. Despite of pharmaceuticals occurring in the aquatic environments at trace levels (ng L\textsuperscript{-1} to low μg L\textsuperscript{-1}), they have been specifically designed to be biologically active at very low concentrations in human tissues and therefore is it reasonable to assume that aquatic wildlife may also be susceptible to their effects particularly under condition of combined and chronic exposure. Hence the need to characterize biological effects in non-target organisms exposed to sub-lethal concentrations of pharmaceutical mixtures. Buprofen (IBU) is one of the most used non-steroidal anti-inflammatory drugs; its ability to induce toxic effects (i.e. oxidative stress, neurotransmitter, endocrine disruption, immunological alterations) in aquatic organisms at environmentally relevant concentrations is has been widely proven. Ciprofloxacin (CIP) and flumequine (FL) are broad-spectrum antibiotics of the fluoroquinolones class. Fluoroquinolones toxicity was observed in rodents
producing among others oxidative stress, cyto, neuro and hepatotoxicity were induced after treatment with CIP in mice and rats. However, ecotoxicological effects on aquatic organisms of CIP and FL are practically unknown. In our study specimens of the clam *Scrobicularia plana* were exposed to control water and a mixture of IBU, CIP and FL at close environmentally relevant concentrations (10 y 100 μg/L each) during 21 days with the aim of studying toxicological responses among different parameters. This study aimed to evaluate the potential effects of antibiotics and their derivatives in the clam *S. plana*. A microtitre assay was performed to assess differences in bacterial sensitivity to antibiotics and their derivatives. The method used in the present work may serve as a quantitative tool to efficiently assess the policy with regard to the pharmaceuticals concerning their environmental risk. Reference (1) Eun Jeong Hatt, Dong Soo Lee. Application of emission estimation model to the environmental risk assessment of the pharmaceuticals commonly used for human and veterinary purposes. Annual Meeting of Society of Environmental Toxicology and Chemistry, Brussels, Belgium, 2017

**WE103**

Changes in the environmental risk of veterinary antibiotics after the introduction of antibiotics-reducing policies

E. Han, D. Lee. Seoul National University / Environmental Planning Institute

Graduate School of Environmental Studies

In recent decades, pharmaceuticals in the environment have been concerns for environmental protection. Exposure to the residual antibiotics in the environment could lead to adverse effects on non-target organisms, contamination of food and drinking water supplies, and increased antimicrobial resistance (AMR). Since 2000s, in Korea, the policies for reducing antibiotics usage, such as Separation of Dispensing and Prescribing of Drug, or Restriction of Adding Antibiotics in Animal Feed, have been enforced in view of public health management. The usage of antibiotics usage has been decreasing since the enforcement of these policies, the assessment for these policies in view of environmental risk has not been performed yet. In our previous work (1), an emission prediction model for calculating the predicted environmental concentrations (PECs) of the active pharmaceutical ingredients (APIs) used only for human but for veterinary purposes was presented. For veterinary usage, the model covers pharmaceutical life cycle posterior to consumption, including direct discharge, manure composting, and land application over the agricultural soil. The emission model was combined with SimpleBox and SimpleTreat into a single spreadsheet-type model for calculating the PECs. In the present study, antibiotics which are of top 26s in veterinary consumption in each year from 2001 to 2016 were selected as target substances. In this period, the environmental risk posed by the regulated antibiotics (Tetracycline, Norfloxacin, etc) has decreased, however, the uses of non-regulated antibiotics (Florfenicol, Tilmicosin, etc) have steeply increased (255 times for Florfenicol, 13 times for Tilmicosin), implying emerging risk. The method used in the present work may serve as a quantitative tool to efficiently assess the policy with regard to the pharmaceuticals concerning their environmental risk. Reference (1) Eun Jeong Hatt, Dong Soo Lee. Application of emission estimation model to the environmental risk assessment of the pharmaceuticals commonly used for human and veterinary purposes. Annual Meeting of Society of Environmental Toxicology and Chemistry, Brussels, Belgium, 2017

**WE104**

Development of microplate based assay and its application to establish differences in cyanobacteria sensitivity to antibiotics

G.C. Le Pagg. University of Exeter / College of Life and Environmental Sci; M. Trznadel, L Gunnarsson, University of Exeter / Biosciences; J. Snape, ASTAZeneca UK Ltd. / AstraZeneca Global Environment; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences

Antibiotics are continuously entering the environment and pose a risk to environmental health through their direct effects on microorganism communities and to human health through antimicrobial resistance. They are designed/select to target bacteria but in current environmental risk assessment (ERA) only one species of cyanobacteria and the activated sludge respiration inhibition test (API) (proven not to be sensitive for antibiotics) are used to represent all bacterial diversity. There is therefore concern that the potential impacts of antibiotics on environmental health are not fully considered in ERA. We have developed a microtitre assay that broadly follows and meets the validity criteria of the OECD 201 test guideline as a cost effective way to determine the effect of antibiotics on cyanobacteria growth. We applied this assay to determine growth-rate effects on 8 species of cyanobacteria of different cultivated species and species sensitivity for the improvement of the ERA of antibiotics. Our key findings are: 1) the performance of the microtitre assay is suitable for accurate and reliable assessment of effects on growth in a wide range of bacterial species; 2) differences in cyanobacteria sensitivity to antibiotics can span several orders of magnitude; and 3) the current framework for ERA of antibiotics inadequately addresses the risk to bacterial populations and testing several diverse cyanobacteria species will increase confidence in the protection goals established.

**WE105**

Direct and indirect effects of antibiotics in the leaf-shredding macroinvertebrate Gammarus fossarum

M. Konrath, University Koblenz-Landau / Institute for Environmental Sciences; J.P. Zubrod, University of Koblenz-Landau / Institute for Environmental Sciences; P.T. Baudy, University of Koblenz-Landau / Institute for Environmental Sciences; S. Lüderwald, Universität Koblenz-Landau / Institute for Environmental Sciences; C. de la Torre, University of Koblenz-Landau / Institute for Environmental Sciences; R. Schul, University of Koblenz-Landau / Institute for Environmental Sciences; R. Bendschuh, SETAC Europe Office / Department of Aquatic Sciences and Assessment

Recent studies indicated that both leaf-decomposing microorganisms (i.e., bacteria and fungi) and macroinvertebrate detritivores (i.e., shredders) can be affected by antibiotics via direct and indirect pathways (i.e., via altered microbial community structure). However, relatively little is known about these effects on shredders. Therefore, we performed a comprehensive study involving three experiments, which aimed at unravelling the importance of waterborne and diet-related effects of the antibiotic ciprofloxacin (CIP) on the model shredder *Gammarus fossarum*. During a 7-day feeding activity assay, we assessed the effects of waterborne CIP exposure on gammarids’ survival and feeding activity, while alterations in leaf palatability for *G. fossarum* due to microbial colonization of the leaves in the presence of the antibiotic were investigated using food choice assays (i.e., diet-related pathway). Furthermore, during a long term assay of 24 days, sublethal effects (the shredders’ energy processing and physiological fitness) were assessed when either subjected to a continuous exposure to CIP, or to a waterborne and diet-related exposure to CIP. The study aimed to establish an integrated model that covers pharmaceutical life cycle posterior to consumption, including direct discharge, manure composting, and land application over the agricultural soil. The emission model was combined with SimpleBox and SimpleTreat into a single spreadsheet-type model for calculating the PECs. In the present study, antibiotics which are of top 26s in veterinary consumption in each year from 2001 to 2016 were selected as target substances. In this period, the environmental risk posed by the regulated antibiotics (Tetracycline, Norfloxacin, etc) has decreased, however, the uses of non-regulated antibiotics (Florfenicol, Tilmicosin, etc) have steeply increased (255 times for Florfenicol, 13 times for Tilmicosin), implying emerging risk. The method used in the present work may serve as a quantitative tool to efficiently assess the policy with regard to the pharmaceuticals concerning their environmental risk. Reference (1) Eun Jeong Hatt, Dong Soo Lee. Application of emission estimation model to the environmental risk assessment of the pharmaceuticals commonly used for human and veterinary purposes. Annual Meeting of Society of Environmental Toxicology and Chemistry, Brussels, Belgium, 2017

**WE106**

Efficacy of removal antimicrobial resistance genes during avian manure composting process

F. Esporón, M. Delgado, INIA - National Institute for Agricultural and Food Research and Technology; M. Ugarte-Ruiz, M. Moreno, UCM; T. Tadeo, INIA - National Institute for Agricultural and Food Research and Technology; A. de la Torre, INIA - National Institute for Agricultural and Food Research and Technology / Environmental Health

Antimicrobial resistance (AR) is an emerging and global problem. Therefore, there is currently a remarkable effort to understand the mechanisms of resistance, to promote the responsible use of antimicrobials and to seek effective therapeutic alternative. While most livestock studies are focused along the food chain, there are few available studies about the role of livestock manure in the spread of AR. The direct application of animal waste (or slurry) to crops may favor the transmission of AR from cattle to vegetables. The objective of this work is to evaluate the impact of the composting process on the persistence of AR genes. For this, a composting of 10 weeks of duration has been carried out from straw and avian manure, from a laying hen production. Composting samples were taken in triplicate at the end of each week, and total DNA was extracted from each. 22 genes coding for resistance to tetracyclines, sulfonamides, phenicols, aminoglycosides, quinolones, beta lactams, vancomycin and colistin were detected and quantified by real-time PCR. 16 of the 22 genes were detected in at least one sample. Analysis of the temporal evolution of the resistances shows that there is a marked reduction (> 97%) in the genes coding for tetracycline, b-lactam, quinolone and macrolide resistances, while an increase in aminoglycoside and sulfonamide resistance genes is observed. These genes usually form part of integrons, which have more persistence into the environment. Besides, we have found positive correlations among almost all ribosomal protection genes and with the deactivation genes; whereas efflux pump genes were positively correlated among them, suggesting that the persistence of antimicrobial resistance genes could be related to their mechanisms of action. In conclusion, although the composting process does not end up eliminating the AR genes, it can be considered a alternative to the environmental management of the avian manure. RTA2014-00012- C03-02 and S2013/ABI-2747.

**WE107**

Environmental Assessment Of Multi-Class Pharmaceutical Residues In The Tejo Estuary

S. Leston, CFE-Center For Functional Ecology / Department of Life Sciences
University of Coimbra; A. Freitas, A. Vila-Pousca, INIAV- Instituto Nacional de Investigação Agrária e Veterinária; J. Rosa, CFE Centre for Functional Ecology / Department of Life Sciences University of Coimbra; J. Barbosa, INIAV- Instituto Nacional de Investigación Agrária e Veterinária; F. Ramos, Faculty of Pharmacy University of Coimbra; P. Reis-Santos, L.A. Duarte, M.P. Pais, MARE - Marine and Environmental Sciences Centre; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCSUL; V.F. Fonseca, MARE - Marine and Environmental Sciences Centre

Environmental pharmaceuticals contamination is now a recognized threat in coastal and estuarine ecosystems representing unknown and potentially harmful effects to non-target organisms. It is therefore paramount to monitor their presence in the environment and to evaluate the extent of their influence. The Tejo estuary, located on the Atlantic coast of Portugal, was established as a high priority area due to the environmental occurrence of pharmaceuticals due to the proximity to very urbanized areas in the Great Lisbon Region, with sewage disposal and discharges from industries, hospitals, agricultural and fish farms in upstream areas as well as urban effluents, anticipating the presence of contaminants. A monitoring campaign was conducted during summer where water, sediment, macroalgae, invertebrates and fish were sampled for pharmaceutical determination. Thirty sampling stations were selected according to their proximity to discharge points where effluents were expected to be rich in pharmaceuticals but also including reference sites where contamination was expected to be very low. Multi-residue multi-class analytical methods developed for each matrix are being applied for the detection and quantification of 67 compounds. The compounds monitored included antiinflammatory and antiparasitic agents, benzodiazepines, angiotensin receptor blockers, b-blockers and antibiotics (42 compounds) in a total of 67 drugs. Multi-residue multi-class analytical UHPLC-ToF MS methods developed for each matrix are being applied for the detection and quantification. The knowledge gathered will then be applied to exposure assays and antibiotic resistance studies using the pharmaceuticals detected at the highest concentrations and enclosure. The knowledge gathered will then be applied to antibiotic resistance studies using the pharmaceuticals detected at the highest concentrations.

WE108 Environmental risk of enrofloxacin used in aviculture
M. del Álamo, M. Delgado, F. Esperón, INIA National Institute for Agricultural and Food Research and Technology; M. González, INIA National Institute for Agricultural and Food Research and Technology / CISA; J. Tadeo, INIA National Institute for Agricultural and Food Research and Technology; A. de la Torre, INIA National Institute for Agricultural and Food Research and Technology / Environmental Health

The objective of this study is to measure the distribution of select antibiotics currently in use within the farm environment, relating their presence to the length of use and the last date of prescription. For this purpose, specific optimized analytical methods including 19 antibiotics belonging to 10 different families were employed for clean-up and pre-concentration of different matrices (slurry,soil,milk) by means of liquid-liquid extraction, followed by solid-phase extraction (SPE) and identification and quantification by liquid chromatography-mass spectrometry (LCMS). For instance, several veterinary antibiotics under study were detected in wastewater slurry with concentrations up to 18.6 µg L−1 for oxytetracycline suggesting a high number of reservoirs for the antibiotic active substance as part of a repeated test. As test organisms Synechococcus leopoldinis (limnic cyanobacteria) and Synechocystis sp. (marine cyanobacteria) were selected. The tests were carried out on a 24-well microwell plate. In the test, the percentage inhibition of the growth rate (cell number) is determined in comparison to the negative control over a period of 72 hours. The derived EC50-values after repeated exposure were compared for different antibiotics of environmental concern. The investigations are carried out as part of the PharmCycle project.

WE111 Impact of antibiotics on the feeding rate of the freshwater shrimp Gammarus pulex
G. Consolandi, University of Portsmouth; M. Bloor, University of Portsmouth / School of Earth and Environmental Science; A. Ford, University of Portsmouth / Biological Sciences

Antibiotics are one of the main categories of pharmaceuticals and their release into the freshwater environment can impact the natural bacterial and fungal communities, which can threaten the survival of organisms that rely on them as a food source. One such organism is the freshwater detritivore Gammarus pulex that commonly feeds on detritus such as, naturally conditioned Alnus glutinosus leaves. The study aim was to establish if the feeding rate of Gammarus pulex was altered when their food source was Alnus glutinosus was exposed to environmentally realistic concentrations of antibiotics during the natural leaf conditioning process. The investigation included three antibiotic scenarios (1) exposure to the bacteriostatic agent Tetracycline, (2) exposure to a mixture of Sulphamethoxazole and Trimethoprim bacteriostatic agents that are commonly prescribed together and (3) exposure to the bactericidal agent Ciprofloxacin. 24 h feeding assays were performed using Alnus glutinosus leaf discs of 1.3 cm Ø and standardised Gammarus pulex specimens (n=60). The organisms were kept at 15°C under a 12:12 h light:dark cycle. 15 replicates were undertaken with three environmental realistic concentrations and a charcoal filtered tap water control (200 mg/L, 20 mg/L and 2 mg/L). The leaf discs were photographed at the start and finish of the investigation and these images underwent analysis with ImageJ software in order to calculate the area consumed. After 24 h, the Gammarus pulex were sacrificed by exposure to −20°C temperature before being dried at 60°C for 24 h and weighed. This protocol was performed with antibiotic scenario 1, 2 and 3. The results showed that Tetracycline (Z=0.198, p=0.897) and Ciprofloxacin (Z=1.568, p=0.119)
p=0.667) were not a concern in relation to feeding at environmentally realistic concentrations (scenario 1 and 3), (p=0.05). When exposed to a mixture of Sulfamethoxazole and Trimethoprim (scenario 2) there was an impact on the 
\textit{Gammarus pulex} feeding rate (Z=13.239, p=0.004). However, further investigation would be required to investigate these drugs individually to identify if the obtained results were driven by one or the combination, and also to establish if there is a genuine environmental concern associated to this mixture or if the data is blurred in some way.

**WE112** Persistence of the sulfamethoxazole antibiotic in a digestate-amended agricultural soil


Thousands of tons of antibiotics are annually used in human and veterinary medicine worldwide. They are excreted, from the treated organism, either unaltered or as metabolites, reaching soil and water ecosystems. In particular, the use of wastewater, sewage sludge, livestock manure and digestate as agricultural amendments and fertilizers, introduce residual concentrations of antibiotics to soils. Livestock raising practice involves the use of antibiotics in feed; consequently digestate obtained by anaerobic digestion of manure may be an additional source of antibiotics and resistance genes in soil. Sulfamethoxazole (SMX) is one of the most commonly prescribed and consumed sulfonamide antibiotics, due to its ability to inhibit Gram-positive and Gram-negative bacteria; it is used in veterinary practices, aquaculture and livestock breeding both for treating diseases and promoting growth. However, current knowledge about its persistence and possible environmental effects is poorly understood. In the present study, we investigated the persistence and the possible effects on the soil natural microbial community of SMX in an agricultural soil amended with solid anaerobic digestate from bovine manure anaerobic fermentation. Microcosms, containing soil and digestate treated with 20 mg/Kg of SMX, were set up in the presence/absence (sterilized soil) of the natural microbial community. Moreover, non-antibiotic-treated microcosms were used as microbiological controls. At fixed times (0d, 7d, 13d, 20d, 61d), SMX residual concentrations (ASE extraction and HPLC-UV detection) and microbiological parameters (cell viability, abundance and activity) were analysed. Finally, a molecular marker for antibiotic resistance, the intI1 gene, was investigated at the start and the end of the experiment using qPCR. Results showed that although an acute negative effect (0d) was observed on the microbial abundance and viability, the antibiotic was degraded in just a few days. Interestingly, the intI1 gene was found in the soil where the digestate was added, showing its introduction through this agricultural practice.

**WE113** Pollution in the Mooi River: Fluconazole and fluconazole resistant pathogenic yeasts species

M.E. Monapathi, North West University (Potchefstroom Campus) / Microbiology

The presence of yeast species in water sources that are associated with faecal pollution have been demonstrated. Some of the isolated species are potentially pathogens and could cause superficial and life-threatening infections. Fluconazole on the other hand is the most used antifungal agent in the treatment of yeast infections as well as prophylactic agent to prevent Candida and Cryptococcus infection in HIV patients. The aim of the study was to determine yeast pollution, susceptibility of these to, and the levels of, fluconazole in the Mooi River, North West (South Africa). Yeast isolates were enumerated using membrane filtration, selective media and incubation at 37°C and identified using biochemical methods (staining and 26S rRNA gene sequencing). Resistance to fluconazole was determined by disc diffusion. Environmental DNA was isolated directly from water using membrane filtration and a commercial DNA isolation kit. Yeast levels as inferred by qPCR of 26S rRNA gene levels were determined. For fluconazole resistance, yeast isolates were analysed using solid phase extraction. The extracts were analysed with liquid chromatography coupled to a quadrupole time-of-flight mass spectrometer. The purified isolates identified included Candida albicans, C. krusei, C. tropicalis and Saccharomyces cerevisiae. The yeasts identified have been associated with polluted waters. Some isolates in the present study are pathogenic and have a direct contact with polluted water could cause infections to immune compromised people and were all resistant to fluconazole. Quantitative PCR of the 26S rRNA gene indicated that a high number of gene copies were present at all sites. Fluconazole levels ranged from

**WE114** Reactivity, mobility and degradation of the antibiotic Sulfamethoxazole and its impact on the microbial communities of an agricultural soil amended with organic waste products

J.M. MARTINS, CNRS IGE UMR 5001, Univ. Grenoble / OSUG-IGE; E. François, L. Spadini, J. Granat, C. Humbert, E. Vinc, M. Morel, Institut Geoscience & Environment

The fate of Sulfamethoxazole (SMX), a sulfonamide antibiotic widely spread in natural soils and waters, was evaluated in batches and columns of a silty-loam soil under culture from Feucherrors (INRA Versailles, France). SMX revealed to be a weak sorbent since in batches only 10% of SMX sorbed at a solid/solution ratio of 0.1. It’s sorption increased strongly with soil organic matter content (addition of manure), indicating that the essential feature of OM addition is an increase in sorption sites density at almost constant sorption strength, and confirms previous results about the strong influence of sorbed complexants such as Cu(II). The mobility of SMX evaluated in water-saturated columns showed higher mobility of SMX than expected from the sorption study. Interestingly, this increased mobility was reduced by the soil’s organic matter content, suggesting that mobility of SMX decreases to antibiotics transport in soils. Batch degradation experiments revealed that SMX removal is quite fast with half-life values ranging between 18 and 350 days in non-sterile and sterile soils. This degradation process was shown to occur principally in both the coarsest and finest soil-size fractions, while almost no biodegradation was observed in the mass-dominant silt fraction of the soil in agreement with its low microbial biomass content. The impact of SMX on the soil bacterial community, evaluated through total biomass (16SDNA), qPCR (Antibiotic Resistance Genes, ARG, sul1 and sul2), DGGE fingerprinting and high throughput sequencing revealed important impacts of SMX on soil microbial biodiversity and species richness and the emergence of specific taxa, resistant to the antibiotic. These results permitted to characterize the global fate and impact of SMX in an agricultural soil. SMX was present in mobile DNA with enhanced mobility in presence of added OM. SMX appeared also quite readily biodegradable, especially when in contact with coarse and fine soil size fractions, where it had the strongest impact on soil bacteria. Keywords: Antibiotics, SMX, organic matter, impact, DGGE, Miseq, ARG, biodegradation.

**WE115** Risk assessment of antibiotic resistance and related genes in human impacted environments

J. Mauuirnen, University of Helsinki / Food and Environmental Sciences; K. Parnänen, J. Hultman, W. Muziasari, University of Helsinki; R.D. Stedtfeld, J.M. Tiedje, Michigan State University / Center for Microbial Ecology Department of Civil and Environmental Engineering; M. Virta, University of Helsinki

The origins of antibiotic resistance in the environment is relevant to human health because of the increasing importance of zoonotic diseases as well as the need for predicting emerging resistant pathogens. Antibiotics are used in diverse settings for food production. Domestic animals are treated with antibiotics for both curing diseases and promoting growth. Aquatic environments are also a major source for managing infectious disease. Wastewater treatment plants receive sewage from various sources, including hospitals and households which are both important sources of antibiotics and their residues, and antibiotic resistant bacteria. Risk assessment of antibiotic resistance is complicated. It should include at least quantitative information of the gene, sequence of the gene, host cell of the gene and genetic environment. We have used the combination of different methods for obtaining that information: Parallel quantitative PCR array for high throughput quantification 1, epicPCR(2) for host information and Inverse-PCR(3) for analysis of the genetic environment. Inverse-PCR and epicPCR combined with DNA sequencing resolve also the sequence of the resistance gene. Samples were collected from different locations in Finland: manure from cattle and pig farms, soil that received the manure as fertilizer, sediments from aquaculture farms and effluent, influent and activated sludge from waste water treatment plant. Our results demonstrate that human activities results to the increase to the abundance of antibiotic resistance genes. In many cases the genes are located in mobile genetic elements with increases the probability of transfer of the them between bacterial species. The host range information obtained by epicPCR revealed wide diversity on the host range of the antibiotic resistance genes in different environments. Our results can be used for the development ecotoxicological risk analysis for antibiotic resistance. (1) Karkman, A., Johnson, T.A., Lyra, C., Stedtfeld, R.D., Tamminen, M., Virta, J.M. and Viarta, M. (2016) FEMS Microbial Ecology 92 (3): ftw014 (2) Spencer, S.J., Tamminen, M., Stedtfeld, R.D., Gaze, W., Groot, H., Griffiths, H., Muka, L.K., Vigneault, F., Virta, M. and Alm, E.J. (2016) ISME Journal 10:427-436 (3) Parnänen, K., Karkman, A., Tamminen, M., Lyra, C., Paulin, L., Hultman J and Virta, M. (2016) Scientific Reports 6: 35790

**WE116** Risk of antibiotics in the environment

D.d. Silva Tavares Duarte, Radboud University / Department of Environmental Science; R. Oldenkamp, Radboud University Nijmegen / Department of Environmental Science; A.M. Rasig, Radboud University / Department of Environmental Science

For decades, pharmaceuticals have been fundamental tools against disease and infection targeting humans and animals. Antibiotics in particular have played a decisive role due to their ability to inhibit growth or eliminate microorganisms. Unfortunately, its misuse combined with bacterial capability to acquire antibiotic resistant genes, have significantly contributed to the escalation of life-threatening
infections leading to worldwide antimicrobial resistance (AMR). This issue is most evident in artificial high selective pressure settings (e.g. hospitals, animal farms) but the increasing occurrence of antibiotics and resistance genes in the environment is spawning serious concern. The measured concentrations of antibiotics are relatively low, most are readily biodegradable and there are considerable resistance-associated fitness costs. However, intricate bacterial compensatory mechanisms, population dynamics and long-term persistence can lead to resistance gene emergence and enrichment (e.g. via horizontal gene transfer). Therefore, there is a need for a better understanding of how concentrations of antibiotic relate to the abundance of resistance genes in different environmental compartments under different conditions. In this study, we compiled this sparse information by conducting an extensive literature meta-analysis to evaluate global trends. Our investigation indicated that environmental matrices undergoing high antibiotic abundance (e.g. surface water). Interestingly, there are cases where gene variation is weakly correlated with antibiotic concentration (e.g. sediment) which challenges the common proportionality assumption between these two parameters. This indicates that AMR genes can be highly maintained throughout bacterial communities under certain environmental conditions. Whether detected gene levels are antibiotic-induced or the consequence of previous changes in gene abundance (e.g. water flow). Antibiotics make up a significant proportion of the pharmaceuticals prescribed and consumed in Kazakhstan and the topic is a new field for research in Kazakhstan. Antibiotics are pollutants of increasing interest. The volume of the antibiotic use in Kazakhstan on representative aquatic species.

WEI17 Sulfamethoxazole degradation in river water microcosms and effect on the natural microbial community

The widespread use of antibiotics causes concern on their occurrence and fate in different environmental matrices. Following administration, antibiotics are only partially metabolized and a large amount is excreted unaltered or as active metabolites, reaching wastewater treatment plants (WWTPs). Most WWTPs are not able to remove them efficiently and through their effluents, they reach surface water. The synthetic compound sulfamethoxazole (SMX) is one of the most prescribed and consumed sulphonamide antibiotics to treat urinary tract infections used both in human and veterinary practices. The widespread use of SMX implies its antibiotic-induced of the natural microbial community, e.g. fungi, microorganisms and plants. SMX is largely biodegradable and resistant to hydrolysis. The high frequency of detection and relative persistence of SMX in environment cause a potential risk of antibiotic resistance spread in ecosystems. Multiple mechanisms confer sulfonamide resistance in bacteria, although data on biodegradation and spread of antibiotic resistance genes (ARGs) in natural water ecosystem are quite scarce. The aim of the present work was to investigate the SMX degradation in natural river water in presence/absence of the microbial community and to identify the occurrence of sul genes associated to the antibiotic resistance. Microcosm experiments were set up using river water treated with 500 µg/L of SMX. At fixed times, water sample were collected for chemical (SMX residual concentrations) and microbial analysis. The disappearance time of 50% of the initial SMX concentration (DT50) and the effects of the antibiotic on the natural microbial community were evaluated in terms of cell viability and abundance. Moreover, the spread of sulfonamides resistance genes was evaluated by quantifying the sul I gene. The antibiotic SMX was biodegraded with a DT50 of about 20 days. The microbial abundance not only was not affected by the antibiotic addition (t=0 days), but at the end of was significantly higher in treated microcosms than in control conditions. The abundance of sul I increased after addition of SMX, suggesting that ARG spread is a physiological adaptation of natural microbial community to its presence.

WEI18 The effect of antibiotics on representatives of aquatic algal and plant species B. Fifi, B. Randazzo, O. Carnevali, F. Maradonna, Università degli Studi di Padova; A. Fifi, Biotecnologie B.T. Srl / Ecotoxicological Politecnica delle Marche; M. Magro, E. Bonaiuto, F. Vianello, G. Chemello, The University of Nottingham / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering

In the present study, we evaluated the ecotoxicological effect of antibiotics on growth of aquatic macrophytes by comparing the effects of antibiotics on growth of Chlorella sp. and Lemna minor. Five major use antibiotics (e.g. amoxicillin, clarithromycin, azithromycin, sulfamethoxazole, oxytetracycline) and their mixture were used in the experimental assessments. The compounds were selected based on a previous prioritization study based on the risks of active pharmaceutical components (APIs) to aquatic environments in Kazakhstan.

The study on Lemna minor was conducted according to the OECD Guidelines for the testing of chemicals 221. Lemna minor species were cultured in Swedish Standard (SIS) growth medium and effects of the antibiotics on growth assessed over 7 days. The results of the study showed EC50 values of each test compounds ranged from 2.8 to 21.8 mg/L. The test on algae was conducted according to the OECD Guidelines for the testing of chemicals 201. Chlorella sp. were cultured in Tamiya medium and algae numbers were counted in Goryaev chamber under a microscope. The macroside substances azithromycin and clarithromycin were found to be the most toxic compounds to the algae with EC50 values being lower than 1 mg/L. In the future, it is recommended to perform assessments on the sensitivity of other less well studied aquatic species to priority ARPs. AMR is one of the global threats to human health as well as monitoring studies to establish levels of exposure in the country. This will then provide a basis for the risk of these substances to be established.

WEI19 The Presence of Human and Veterinary Antibiotics in Urban and Rural Streams in North Carolina
A.D. Gray, University of North Carolina at Greensboro / Biology; D. Todd, University of North Carolina at Greensboro / Chemistry; A.E. Hershey, University of North Carolina at Greensboro / Department of Biology

Antibiotic pollution is of concern to environmental health sciences due to the implications associated with their presence in the environment. There is a great deal of literature drawing attention to antibiotics in the environment contributing to antibacterial resistance amongst bacteria. Antibiotic pollution in stream ecosystems in the United States remains a research area that has received little attention, while more research has focused on antibiotics in larger rivers, lakes and estuaries.

Streams ecosystems play a crucial role in the transport of water from inland areas to coastal waters as well as to rivers and lakes, and have greatest potential to mitigate antibiotic resistance spread in ecosystems. For instance, the presence of ARGs in river systems demonstrates the potential for antibiotics to be transferred from inland areas into larger water bodies. Antibiotics entering streams can arise from various sources. In urban areas, antibiotics of human and veterinary origin can enter streams due to runoff or leaching from surrounding areas, but most notably from wastewater discharges that release antibiotic directly into streams. In rural areas, antibiotics can enter streams from application in the maintenance of livestock, which due to runoff and leaching, can contribute to veterinary antibiotics being present in rural streams and groundwater. Work from the present study found human and veterinarian antibiotics in both urban and rural streams. Antibiotics detected include sulfamethoxazole, sulfamerazine, trimethoprim, danofloxacin, sulfafuinazoline, streptomycin, enrofloxacin, and tylosin, with several of the detected antibiotics being present in both urban and rural streams. Results from this work demonstrate that streams are key sites regulating discharge of antibiotics to larger bodies of water and that surrounding land use and infrastructure influence the presence of antibiotics in streams in urban and rural areas.

WEI20 The Role of Water Quality Analysis: Understanding our process environment to inform AMR.
T.P. Dodsworth, The University of Nottingham / Biosciences; R. Hellwell, The University of Nottingham / Social Sciences; E. King, The University of Nottingham / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering

Water Quality Analysis (WQA) can be used as a tool for understanding key components of systems under study outside the scope of microbiology. Specific strategies that release compound directly into streams. In rural areas, antibiotics can enter streams from application in the maintenance of livestock, which due to runoff and leaching, can contribute to veterinary antibiotics being present in rural streams and groundwater. Work from the present study found human and veterinarian antibiotics in both urban and rural streams. Antibiotics detected include sulfamethoxazole, sulfamerazine, trimethoprim, danofloxacin, sulfafuinazoline, streptomycin, enrofloxacin, and tylosin, with several of the detected antibiotics being present in both urban and rural streams. Results from this work demonstrate that streams are key sites regulating discharge of antibiotics to larger bodies of water and that surrounding land use and infrastructure influence the presence of antibiotics in streams in urban and rural areas.

WEI21 Safety and efficiency assessment of antibiotic administration by magnetic nanoparticles in Zearafish
G. Chemello, C. Piccinetti, B. Randazzo, O. Carnevali, F. Maradonna, Università Politecnica delle Marche; M. Magro, E. Bonaiuto, F. Vianello, G. Chemello, Università degli Studi di Padova; A. Fifi, Biotecnologie B.T. Srl / Ecotoxicological and chemical; F. Gigliotti, CRO BioTechnologie BT; I. Olivotto, Università Politecnica delle Marche
The indiscriminate use of antibiotics in the aquaculture sector has raised public concern because of possible toxic effects, development of bacterial resistance, and accumulation of residues in individual tissues. Even if several countries have developed regulations about their use, it is clear that long-term growth of the aquaculture industry requires both ecologically sound practices and sustainable resource management. Alternative strategies for better management of antibiotic administration are of prime interest to improve antibiotic use rates and, as a consequence, reduce their release into the aquatic environment. The present study investigates, for the first time to our knowledge, a new methodology for oxytetracycline (OTC) administration through the use of iron oxide nanoparticles (NPs) (made of maghemite γ-Fe₂O₃) in zebrafish (Danio rerio). Fish were divided into 4 experimental groups: control; group A exposed to 4mg/L OTC (through water); group B: iron oxide nanoparticles (NPs) administered at 10mg/L; and group C exposed to 4mg/L OTC, and group C exposed to bare NPs. HPLC analysis, histological analysis and other methods were applied to perform different evaluations. No detoxification processes or anatomical alterations were observed in fish exposed to bare NPs. Exposure of fish to the SAMNIs@OTC complex resulted in a 10 times higher OTC accumulation with respect to using water exposure. This new method for OTC administration seems more efficient with respect to the traditional way of exposure and shows the potentiality to reduce antibiotic utilization and possible environmental impacts.

Analysis and Fate of Emerging Contaminants in soils, water and plants under water scarcity (P)

Identifying and Controlling Sources of Ultra-Trace Metals in Control Blanks and Ensuring High-Quality Data for Sensitive Environmental Risk-Based Decisions

R. Vitals, Environmental Standards; L. Dupes, A. Reed, Environmental Standards Inc; M. Mc Anulty, BP Exploration

The control of blank contamination is a necessary requirement when evaluating the qualitative and quantitative accuracy of analytical results for decision-making purposes of site delineation, toxicological evaluations, and site remediation. This control is essential to differentiate actual site concentrations from potential sources of contamination within the site or outside the background site metals conditions and cleanup criteria. Trace-level concentrations of total and dissolved metals were observed in several equipment rinse空白 samples collected at multiple sites during the field sample collection season of 2014 through 2016. The detection of total and dissolved metals in these field quality control (QC) samples resulted in qualification of both total and dissolved sample results resulting in questions regarding the presence or absence of low-level site contamination. Although equipment rinse空白 samples do not have specific contamination acceptance criteria due to the field collection process, the goal of equipment rinse空白 blanks is to verify that contamination was not introduced during the sample collection process or by sampling equipment. The purpose of the investigation and identification was to determine potential sources of metals contamination in equipment rinse空白 blanks that could be identified, reduced, or eliminated. Multiple avenues of potential contamination were investigated including a study of sample tubing, peristaltic pumps and in-line filters; field observation of equipment blank collection processes; initial and post water-quality monitoring; sample bottle cleanliness and storage of deionized water for use in collection of the equipment rinse空白 blanks. This presentation will provide details of the investigation process and result after implementation of several important corrective actions.

WE123 Comprehensive Analysis of Elemental Contamination in Environmental Samples with Limited Guidance Using Ion Chromatography Mass Spectroscopy (ICP-MS)


The analysis of elemental contamination is a significant task for laboratories working in environmental analysis. Besides direct regulation of contaminant levels, for example in waters, also a number of other sample types must be screened, such as samples of sediments, sludge, or biota. Targeted elements comprise the “big four“, arsenic, cadmium, mercury and lead, but also many other elements. Particular challenges in this area include the need to often measure large numbers of samples and potentially complications caused by a variety of spectral interferences. For example, if rare earth elements are present in a given sample, they can lead to severe interferences on arsenic and selenium. To avoid false positive results, triple quadrupole ICP-MS is ideally suited for effectively removing all potential interferences. However, the inherently higher complexity of a triple quadrupole based system in comparison to traditionally applied single quadrupole is a barrier for most laboratories dealing with routine analysis. This presentation will highlight the use of ICP-MS, especially for environmental samples. Dedicated software solutions, such as tools to simplify method development, increase productivity or tackle advanced applications, such as chromatography coupled to ICP-MS analysis, will be presented to show the broadness of accessible applications using modern ICP-MS instrumentation.

WE125 ANALYTICAL METHOD FOR DETERMINATION OF FULLERENE (C60) NANOPARTICLES IN SEAWATER SAMPLES

I.R. Diniz, Universidade Estadual do Maranhão / Agroecologia; L. Capellini, Universidade Federal de São Paulo UNIFESP / Departamento de Química

Fullerenes are allotroic forms of carbon produced in highly energetic processes of various origin or anthropogenic sources. In the last years, the increasing application of nanomaterials in several areas of human endeavor besides their physical and chemical properties, contribute for the growth of the global economy. However, the growing production and application of nanomaterials is also promoting discussions about the possible risks of these compounds to the environment and human health. Data have already been reported on the occurrence of fullerenes in different matrices, including the atmosphere, soils and sediments, and fresh water. Despite this, little information has been related to marine environments while coastal areas and estuaries are suspected to be one of their major sinks. The purpose of this study is developed and optimize an analytical method to evaluate the presence of nanofullerene (C60) in seawater samples. It will be tested two methods of extraction by dispersive liquid–liquid micro extraction (DLLME), and (2) QuEChERS, after, all the samples will be analyzed by liquid chromatography tandem mass spectrometry (LC-MS/MS). Keywords: Marine pollution. Fullerenes. Nanomaterials.

WE126 Screening of per- and polyfluoroalkyl substances (PFASs) and total organic fluoride in wastewater effluent from Nordic countries

F. Chen, MTM Research Centre, Oebro University / SCHOOL OF SCIENCE AND TECHNOLOGY; U. Eriksson, R. Aro, MTM Research centre Oebro University; L. W. Yeung, University of Oebro / Department of Chemistry; T. Wang, MTM Research Center; R. Kallenborn, Norwegian University of Life Sciences / Chemistry, Biology and Food Sciences; A. Karram, Oebro University / MTM Research Centre

The discharge of per- and polyfluoroalkyl substances (PFASs) into the environment via wastewater is a pressing public health issue. Apart from the frequently detected PFASs, such as PFOS and PFOA, more and more novel PFASs have been reported recently. We used the target screening method to identify novel and legacy PFASs in the Nordic environment. The aim of this project is to determine as many PFASs and total organic fluoride as possible in wastewater effluents from the Nordic countries and self-governing areas, including Finland, Sweden, Norway, Denmark, Faroe Islands, Iceland and Greenland. Field collected effluent (250 mL) were extracted by solid phase extraction (SPE). Identification and quantification of target compounds was performed by using liquid chromatography-mass spectrometry (LC-MS/MS) and ultra performance convergence chromatography (UPC²) and combustion ion chromatography (CIC). The significance of the occurrence, levels and patterns of various PFASs in Nordic wastewater effluents are discussed.

WE127 Quantitative evaluation of lag effect in polar organic chemical integrative sampler (POCIS) and modified POCIS with polytetrafluoroethylene (PTFE) membranes

Y. Jeong, H. Kwon, KIST Europe / Environmental Safety Group; H. Jeon, KIST Europe; A. Meyer, E. Furünrock, H. Beck, Saarland University, K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

Increasing occurrence of organic contaminants in the aquatic environment has heightened the need for reliable and efficient monitoring technique. Traditional grab sampling followed by laboratory extraction and instrumental analysis is well established method, but only provides a snapshot of the water quality status. Achieving representative sample with grab sampling takes considerable labour, time and cost. Here, time-integrative passive sampling technique is recognized as a promising monitoring tool. Passive sampling technique allows the simple sampler construction and application, provision of time weighted average concentration and in situ sampling. Various configuration of passive sampling devices are currently available, one of which is the polar organic chemical integrative sampler (POCIS). POCIS consists of Oasis HLB® sorbent sandwiched between two polyethersulfone (PES) membranes and has been widely used for the detection of hydrophobic contaminants in the past decade. However, uncertainties in quantitation of POCIS measurements have been pointed out as a main limitation of POCIS. Compound specific sampling rate depends on sampler configuration and environmental parameters such as flow rate and temperature. Lag effect from membrane sorption within POCIS further complicates the transfer kinetics of analyte. In this study, modified POCIS (POCIS-PTFE) with polytetrafluoroethylene (PTFE) membrane instead of PES membrane was tested in an attempt to avoid or lower the PES membrane sorption. The primary aim of this study is to (1) introduce modified POCIS and (2) identify the membrane sorption within POCIS in order to better understand partitioning kinetics of POCIS. In the laboratory experiment, the analyte mass fraction in membrane relative to total POCIS (i.e., Oasis HLB plus membranes) and membrane-water partition coefficient were determined for a range of compounds (log Kow from -0.03 to 6.26). Less membrane sorption was found in

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PTFE membrane than PES membrane for all target compounds. Two types of POCIS were then deployed in a small river and the outflow of wastewater treatment plant for two weeks. Both POCISs showed similar chemical profile and 22 contaminants were detected including 6 priority substances enlisted in EU Water Framework Directive. Although PTFE membrane showed better permeation performance than PES membrane in laboratory experiment, the lag effect was still found from the field application of POCIS-PTFE.

WE128 Occurrence and Ecological Risk Assessment of Several Endocrine Disrupting Chemicals in Urban River Water and Sediment of South China C. Huang, Jinian University; L. Wu, Y. Guo, Jinian University / School of Environment
This study mainly focused on the occurrence, distribution, and ecological risk assessment of eight selected endocrine disrupting chemicals (bisphenol analogues, parabens, and triclosan) in urban river water and sediment of South China. The eight target chemicals were detected in both water and sediment samples with concentrations ranged from not detected to 66500 ng/L and from not detected to 492 ng/g dw, respectively. Among these eight chemicals, the top three major chemicals were bisphenol A (BPA) (account for 35%), methyl paraben (MeP) (23%), and triclosan (TCS) (14%) in water, while BPA (43%), TCS (37%), and MeP (14%) in sediment. Significant correlations were found between most of the selected EDCs, especially MeP and TCS both in water and sediment (p < 0.01), indicating that these chemicals were in common sources and widely usage. After calibration, our oil displacement extraction (SBE 311.1) in sediments target substances were flowed into Liuxi river annually based on the 89 stream primary (p). The ecological risk assessment showed that TCS was the most dangerous compound to aquatic organisms with average HQ = 1.57 (up to 11.5) in river water and average HQ = 0.74 (up to 3.36) in sediment. And the possible joint toxic effect of selected chemicals showed that aquatic organisms were severely exposed to diverse EDCs. This study suggested that compared to the main rivers, the endocrine disrupting chemicals in streams deserves more attention.

WE129 Occurrence, distribution and fate of pharmaceuticals as chemical markers of contamination from urban sources in the vulnerable area of the Ebro Delta (Spain)
M. Celis, M. Gros, Catalan Institute for Water Research ICRA; M. Farre, IDAEA CSIC Barcelona; D. Barceló, M. Petrovic, Catalan Institute for Water Research ICRA
The Ebro Delta and the upper part of the Ebro basin have widely been exposed to contamination from both agriculture and urban sources, being wastewater treatment plant effluent discharges the dominant contamination pathway. In order to determine the distribution and impact of contamination from urban sources in the vulnerable area of the Ebro Delta, water and sediment samples were collected at different sites, covering reaches of the Ebro river located upstream and downstream WWTPs, lagoons, irrigation channels and coastal areas. Water samples were analyzed using ultra high-performance liquid chromatography coupled to tandem mass spectrometry, using a hybrid triple quadrupole-linear ion trap instrument (UPLC−QqLT−MS/MS). In order to assess seasonal variations, distribution and fate of pharmaceuticals in the Ebro Delta, a continuous monitoring campaign with three sampling campaigns in 2016 were performed, covering autumn, winter and spring-summer. Fifty seven and thirty one out of 81 pharmaceuticals were found in water and sediment samples, respectively. Analgesics/ant-inflammatory, lipid regulators, cholesterol lowering statin drugs and antibiotics were the most frequently detected pharmaceuticals, with the highest concentration found in river water, while the lowest concentration were found in sea water. The occurrences of pharmaceuticals detected in sediment samples showed lower frequency of detection than in water. Nevertheless, some compounds were only found in sediments, and not in water, such as the synthetic glucocorticoid (dexamethasone), the anti-diabetic (glibenclamide) and the diuretic (furosemide). Salicylic acid was the most ubiquitous quantified compound in sediments. In water, the highest numbers in a small river during the wet season, due to lower dilution factors.

WE130 Occurrence of pharmaceuticals and personal care products, and their associated environmental risks in a large shallow lake in north China H. Zhou, P. Zhang, China Institute of Water Resources and Hydropower Research IWRHR; K. li, China Institute of Water Resources and Hydropower Research IWRHR
Eighteen selected pharmaceuticals and personal care products (PPCPs), consisting of five non-antibiotic pharmaceuticals (N-APs), four sulfonamides (SA), four tetracyclines (TC), four macrolides (MC), and one quinolone (QN) were detected in water, pore water, and sediment samples from Baiyangdian Lake, China. A total of 31 water samples and 29 sediment samples were collected in March, 2017. Caffeine was detected with 100% frequency in surface water, pore water, and sediment samples. Carbamazepine was detected with 100% frequency in surface water and sediment samples. Five N-APs were prominent, with mean concentrations of 4.90−266.24 ng/L in surface water and 5.07−14.73 µg/kg in sediment samples. Four MCs were prominent, with mean concentrations of 0.97−29.92 ng/g in pore water samples. The total concentrations of the different classes of PPCPs followed the order: N-APs (53.26%) > MCs (25.39%) > SA (10.06%) > TCs (7.64%) > QNs (3.64%) in surface water; N-APs (42.70%) > MCs (25.43%) > TCs (14.69%) > SA (13.90%) > QNs (3.24%) in sediment samples, and MCs (42.12%) > N-APs (34.80%) > SA (11.71%) > TCs (7.48%) > QNs (3.86%) in pore water samples. The geographical differences of PPCP concentrations were largely due to anthropogenic activities. Sewage discharges from Baoding City and human activities around Baiyangdian Lake were the main sources of PPCPs in the lake. An environmental risk assessment for the upper quartile concentration was undertaken using calculated risk quotients, and indicated a low or medium high risk from 18 PPCPs in Baiyangdian Lake and its five upstream rivers.

WE131 Occurrence of perfluorinated compounds in air, water, soil, sediment, and fishes from the Asan Lake region, South Korea
J. Lee, Y. Lee, J. Lee, Seoul National University; S. Kim, Eulji University; M. Kim, Seoul National University / Department of Health Science; Y. Kho, Eulji University; K. Zoh, Seoul National University / Department of Environmental Health
Perfluorinated compounds (PFCs) are known to be endocrine disrupting chemicals and can cause adverse effects on human health and environment. In July and October 2017, ambient air (n=24), fresh water (n=24), sediment (n=24), soil (n=24) and freshwater fish (n=27) samples were collected in Asan lake region, and the levels of PFCs in samples were measured. The predominant chemical species in freshwater were between Pyeongtaek and Asan cities in Gyeonggi Province, and provides water for nearby industrial complex and agricultural areas. Two large streams join the lake and there are many industrial complexes near the streams. To analyze 16 PFCs, 2 samples were taken at each stream and 8 samples were taken at main lake. Analyses were carried out using LC/MS/MS after solid phase extraction. The results showed that concentrations of ΣPFCs were ND−19.6 pg/m3 (for ∑4 PFCs) in air, ND−447.8 ng/L (for ∑14 PFCs) in water, ND−9.7 ng/g (dry weight) (for ∑4 PFCs) in sediments, ND−7.7 ng/g (dry weight) (for ∑14 PFCs) in soil, and ND−35.9 ng/g (dry weight) (for ∑14 PFCs) in the fish, respectively. The predominant species among the PFCs were perfluorooctanoic acid (PFOA) in air, perfluorooctanesulfonic acid (PFOS) in sediment, soil, and fish, respectively. PFOS and PFOA were detected in all water, sediment, and fish samples. In air, 8% of total PFCs mainly existed as the gas phase compared to particulate phase. In water and sediment, higher levels of some PFCs were observed at the confluence of two streams, implying that anthropogenic activities from industrial complex in the upstream are the main source of contamination. Our study first reported the data of 16 PFCs levels in multimedia environment including air, water, soil, sediment, and fishes in Korea.

WE132 Seasonal changes in water and sediments’ microplastics in a Mexican estuary (Tecolutla).
L. Scherer Hernández, P. Ramirez Romo, U.A.M. Iztapalapa / Hidrobiología Microplastics (MP) are persistent contaminants that reach all environment including air, water, soil, sediment, and fish. MP are transported through oceans and rivers and can cause adverse effects on human health and environment. In July and October 2017, ambient air (n=2), fresh water (n=24), sediment (n=24), soil (n=24) and freshwater fish (n=27) samples were collected in Tecolutla estuary. Water and sediment samples were collected in five different sites in three different climate seasons (northern storms, dry and rainy). In the laboratory water volume was measured and filtered through a cellulose filter (Whatman #40) which was later dried at 50 °C for 24 h. Sediment samples were dried at 50 °C, a 40 g subsample was taken and hydrogen peroxide (30 %) was added to disintegrate all organic matter, followed by a zinc chloride solution (pH = 1.5 g/L) to float the MP particles. Later the solution was decanted through a cellulose filter and dried at 50 °C for 24 h. MP particles on the filters were observed through microscope (Dissecting followed by digital Celestron) and photographs of the particles were obtained with image analysis software. Vortex of the polymer identity was done through Scanning electron microscopy. MP size in water range from 10 to 1,730 µm, and their presence was higher in the northern storms season, followed by dry and rainy seasons with the highest numbers in a small tributary. Sediments had more MP and higher numbers in the dry season, with size ranging from 30 to 2,500 µm with highest numbers in the boat dock. Black was the most abundant color in both matrices followed by blue and red. Most MP were fibers. In conclusion MP were present in water and sediments year round, bigger particles were found in sediments and smaller in water. This is the first evaluation of MP in a Mexican estuary so continuing this type of research is important to break new ground in understanding the relevant processes and effects of MP on ecosystems and human health.
understand the biological significance of their presence.

**WE133**

Simultaneous biodegradation of water treatment additives: Transformation and byproduct formation, impact of biocide shock dosing and salinity

T. Wagner, University of Amsterdam / IBED; J. Parsons, University of Amsterdam / IBED-ELD; A. Langenhoff, H. Rijnaarts, Wageningen University / Environmental Technology; P. de Voogt, University of Amsterdam / IBED

Securing the supply of fresh water to fulfill the demand of the rising world population is identified as one of the largest environmental challenges in the near future. The Water Nexus research program aims at developing integral solutions for problems with water scarcity in delta areas worldwide. A significant fraction of industrial fresh water is uptaken in coastal wetlands. Several treatment technologies such as reverse osmosis, electrodeionization and membrane distillation may facilitate the reuse of discharged brackish cooling tower water. However, cooling towers water contains different water treatment chemicals such as corrosion inhibitors, biocides and antiscalants that hamper the optimal functioning of the treatment technologies by, for instance, membrane fouling. An interesting water pre-treatment option is the use of CW systems such as constructed wetlands (CWs). Biodegradation is one of the main contaminant removal mechanisms in CWs. However, the biodegradation potential of CWs for many of the water treatment chemicals is not well understood. In this study, the simultaneous biodegradation of different representative water treatment chemicals by bacteria from CWs is explored. The representative water treatment chemicals compartments (H-benzotriazole (corrosion inhibitor), DBNA (biocide), glutaraldehyde (biocide), PEG (surfactant) and HEDP (antiscalant). The following questions are addressed: Does shock dosing with biocides affect the CW biodegradation potential for the target chemicals? What is the influence of different salinities on the biodegradation of the target chemicals? Which signature microbial transformation products are being produced by single target chemicals that can be used to monitor CW systems? Are the CW transformation products show ecotoxicological effects? Does the simultaneous biodegradation of multiple water treatment chemicals result in the production of new possibly harmful crosslinked products?

**WE134**

Fate of organic micropollutants in a small river: hydrological and chemical processes

C. Glaser, Center for Applied Geosciences / Center of Applied Geoscience; M.E. Müller, Eberhard Karls Universität Tübingen; F. Faltermeyer, Eberhard Karls Universität Tübingen / Center of Applied Geosciences; C. Zwienen, Environmental Analytical Chemistry, Center for Applied Geoscience, University of Tübingen / Geosciences; M. Schwientek, Eberhard Karls Universität Tübingen; C. Zarfil, University of Tübingen / Center for Applied Geoscience

Knowledge on pollutant transformation from laboratory experiments often fails to describe observations in the field. Thus, the CRC-CAMPOS aims to describe the fate and metabolism of anthropogenic pollutants on the landscape scale in different compartments in the Ammer catchment. This study is part of the subproject ‘Rivers’ and will identify and quantify the dominant processes from hydrology and chemistry which influence the fate of organic micropollutants in river systems. Field investigations take place in the Schönbrunnen River close to Tübingen (Germany) in the southwest of Germany, which is mainly influenced by agriculture. Salt tracer tests are combined with measurements of conservative ions and chemical tracers to deduce the processes occurring on the results of the salt tracer tests and provide information about hydrological loss and gain for the Schönbrunnen River. Dilution, mixing and dispersion processes can be identified with tracer tests and determine the residence time available for pollutant transformation. The quantification of the mass transport of pollutants in the river is possible by analysing conservative ions. This helps to derive and characterize chemical processes like photodegradation, sorption to particles or biochemical processes in biofilms from target screening data, mainly on pesticides. With the collected information from different disciplines, we get a larger picture about the pollutant mass transport in the Schönbrunnen River and adjoining compartments.

**WE135**

Occurrence of pharmaceuticals at extremely high concentrations in surface waters in Nigeria

O.M. Ogunbawo, University of Leeds / Geography (Physical); P. Kay, University of Leeds / School of Geography; L. Brown, University of Leeds / School of Geography(Physical); J. Wilkinson, The University of York / Natural and Built Environments; A. Ruiz, University of York / Environment Department; C. Sinclair, The Food and Environment Research Agency / Centre for Chemical Safety and Stewardship; R. Shabi, Lagos State Environmental Protection Agency

Pharmaceutical pollution of surface waters is increasingly recognized as a global problem, but to date, there have been no detailed studies from most African countries. In this study, the occurrence of 37 pharmaceuticals belonging to 19 therapeutic classes was studied in surface water and effluent in Lagos State, Southwest Nigeria. Samples were collected year-round from 22 surface water sites, and 27 compounds were detected at least once, many at extremely high concentrations. Maximum concentrations for a range of compounds, including trimethoprim, sulfamethoxazole, cimetidine, atenolol, and paracetamol were in the order of 150 microg L\(^{-1}\). The mean concentrations for sulfamethoxazole, trimethoprim, cimetidine, paracetamol, lidocaine, metformin, carbamazepine and atenolol were 55.90 microg L\(^{-1}\), 38.89 microg L\(^{-1}\), 31.62 microg L\(^{-1}\), 24.99 microg L\(^{-1}\), 22.55 microg L\(^{-1}\), 20.98 microg L\(^{-1}\), 15.35 microg L\(^{-1}\), and 15.10 microg L\(^{-1}\) respectively. Venlafaxine has the lowest mean of 4.231 ng L\(^{-1}\) other than the four compounds mentioned above. The results detected. With the help published data from around the world, these values represent several orders of magnitude higher than most studies of pharmaceutical occurrence but similar to some other peak concentrations measured in developing countries such as China and India. Seasonal variations were observed for certain pharmaceuticals, i.e., antibiotics, paracetamol, tramadol, metformin, lidocaine, and carbamazepine which may be related to the endogenous production of this region. The concentration of pharmaceuticals range from a very low concentration of pharmaceuticals to a relatively high concentration of pharmaceuticals. The detection of pharmaceuticals in surface waters in Nigeria is of great concern, as these compounds may have adverse effects on aquatic life due to their low biodegradation and persistence in the environment. The study of the occurrence of pharmaceuticals in surface waters in Nigeria is important for understanding the impact of these compounds on the environment and human health. The results of this study will help policymakers and environmentalists to develop strategies to mitigate the impact of pharmaceutical pollution in surface waters in Nigeria.
The wastewater generated by the human activity contains several anthropogenic contaminants, including emerging pollutants. Sewage sludge is generated during the deprecation process in the wastewater treatment plants (WWTPs). The study of emerging pollutants present in this sludge are far limited comparing with the water, mainly because of the challenge that involve their high content in organic matter making difficult their handling, storage and analysis. In Spain, the 80% of this sludge is used in the agriculture sector as fertilizer, and the presence of pollutants could affect to the surrounding ecosystems. The sludge samples were from different treatment plants next to the Natural Park of the Albufera in Valencia, an area surrounded by 14,000 hectares devoted to rice crops. Samples were extracted by liquid phase extraction (LPE) with mixture of EDTA-McIlvaine buffer (pH 4.1) and methanol, assisted by ultrasound. Then, supernatant was cleaned up by the solid phase extraction (SPE) with StrataX® cartridges and analytes were eluted with methanol at gravity flow. Once extracted, the analytes were identified by liquid chromatography-quadrupole time-of-flight mass spectrometry (LC-QqTOF-MS). As a result 50 compounds were identified, being the pharmaceuticals the most relevant, present in all samples, including nucleotides (adenosine triphosphate), amino acids (phenylalanine) or pesticides (lindane, isothiocyanate, and pyrethrum). On the other hand, several compounds were tentative identified and are pending of confirmation. The results of this study demonstrate the interest of high resolution mass spectrometry to draw the profile of contaminants in solid complex matrices. Furthermore, the data obtained provides information about the potential risk of use the sewage sludge for agriculture. Continue researching is needed to assess the real environmental risk related to this sludge and the sediment, underground and surface water. 

Acknowledgements This work has been supported by the Spanish Ministry of Economy and Competitiveness and the ERDF (European Regional Development Fund) through the project GOL2015-64454-C2-1 "Análisis de riesgos y viabilidad económico-ambiental de la eliminación de contaminantes. Diseño una herramienta de apoyo a la toma de decisiones Eco2TOOLS-DSS, http://www.eco2tools.es/" H, Alvarez also knowledge the same institutions for his FPI grant BES-2016-078612.

WE139 CHLORINATED BENZENES IN FISHES FROM DONGTANG LAKE L.L. Yang, Institute of Water Resources and Hydropower Research; F. Zhang, China Institute of Water Resources and Hydropower Research; E. Zhan, China Institute of Water Resources and Hydropower Research

Chlorobenzenes (CBs) are of worldwide concern due to their persistence, toxicity, bioaccumulation, and long-range transport. Hexachlorobenzene (HCB) and pentachlorobenzene (PeCB) are listed as persistent organic pollutants (POPs) by the United Nations Environment Program (UNEP). CBs production in China accounts for 50% of global production. The production of CBs in China surrounded by 14,000 hectares devoted to rice crops. Samples were extracted by liquid phase extraction (SPE) with StrataX® cartridges and analytes were eluted with methanol in aquatic organisms—especially the aquatic organisms in typical epidemic areas of schistosomiasis prevalence in China are lacking. The release of CBs from the production and use of Sodium pentachlorophenate (Na-PCP) has been identified as one of the most important sources. Dongtang Lake is the second largest fresh water lake of China, which is also an area with most widely distributed oncomelaniahispinosa and has the most severe schistosomiasis epidemic situation in China. Na-PCP has been sprayed as molluscicide in Dongtang Lake from 1960s to 1990s, it was estimated that over 9.8x106 kg of Na-PCP had been devoted into the lake; CBs were also carried into the lake with using of Na-PCP. The aims of this study were to investigate/eccurrent contamination status, distribution of CBs in fish from Dongtang Lake.

WE140 Occurrence of bisphenol A in Mediterranean mussels (Mytilus galloprovincialis) sampled from the north Adriatic coastal waters (Slovenia) V. Čekvenik Plais, University of Ljubljana, Veterinary Faculty / Veterinary Faculty; I. Fonda, Fonda d.o.o.; M. Gombač, University of Ljubljana, Veterinary Faculty From January to October 2015 in total 27 samples of Mediterranean mussels (Mytilus galloprovincialis) and 10 samples of sea water was collected along the Slovenian coast in the north Adriatic sea to be tested for the presence of bisphenol A. Samples were collected at three shellfish farms, at the open sea and also from the harbor of Koper. One mussel sample from the harbor of Koper was also collected. Homogenised mussel tissue, shells, and sediment were extracted with acetonitrile and purified with the two solid phase extraction (SPE) steps, using at first hydrophobic polystyrene-divinylbenzene (PS/DVB) copolymer Chromabond HR-X and secondly molecularly imprinted polymer (MIP) AFFINIMIP® SPE Bisphenol A. After adjustment of pH of water samples to the value of 5, these were also applied on the MIP SPE sorbent. Sample extracts were analysed by isocratic (sea water) or gradient (tissue, shells, sediment) reversed-phase HPLC using water and acetonitrile component of mobile phase, Hypersil Gold C18 (3 µm particle size) analytical column and fluorescence detection at excitation and emission wavelengths of 230 and 315 nm, respectively. Mean recovery rates for mussel tissue, shells and sea water were 47%, 73% and 84%, respectively. Concentrations of bisphenol A in tissues of mussels from the farms (n = 20), open sea (n = 6) and a harbour (n = 1) were < 0.03 – 0.28 µg/kg w.w., < 0.03 – 0.46 µg/kg w.w. and 0.21 µg/kg w.w., respectively, while shells of mussels, from farms (n = 20), open sea (n = 6) and a harbour (n = 1) contained 0.01 – 0.20 µg/kg w.w. and 0.04 – 0.27 µg/kg w.w. of bisphenol A, respectively. Saltwater at shellfish farms (n = 5), open sea (n = 4) and a harbour (n = 1) was contaminated with < 0.003 – 0.013 µg/L, 0.004 – 0.009 µg/L and 0.016 µg/L of bisphenol A, respectively. The observed concentrations indicate a relatively low contamination of the Slovenian coastal waters as a part of the north Adriatic sea, with bisphenol A, compared to available publications about Mediterranean mussels.

WE141 Toxicity of non-steroidal anti-inflammatory drug and the behavioural response in Juvenile Catfish I.O. Erunmunwuse, University of Benin, Benin City, Nigeria / Animal and Environmental Biology, I. Tongo, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences, Department of Animal and Environmental Biology, University of Benin, Nigeria; A. Muhib, University of Benin Benin City / Department of Environmental Management and Toxicology

The increasing levels of Pharmaceutical products in surface and underground water in third world countries is on the increase. We examined the toxicity of one non-steroid anti-inflammatory drug and the behavioural response in Juvenile Catfish (Oreochromis niloticus) and the most commonly used anti-influenza drug, Tamiflu in the water and sediment samples from the 56th life stage of Africa Cat Fish Clarias gariepinus using OECD 210 guideline. A 96hrs acute toxicity test protocol for African catfish was established and adopted using a static renewal assay. Fish were exposed for 96 hours assay to varying concentrations of 50, 100, 300, 500, 700 and 800mg/L. Mortality and behavioural changes were used as endpoint for acute test. Behavioural changes were characterized by restlessness, loss of body balance, gape, rise and up and down movements. Estimated LC50 value was 358.80mg/L and the derived safe concentration value was 35.80mg/L. With survival from the range Finding Test, NOEC was 100mg/L and LOEC was 150mg/L. No acute toxicity effects were observed for concentrations below < 100mg/L. The 24, 48, 72 and 96hrs median lethal concentration LC50 values of Acetaminophen was 800, 700, 594.5 and 358.80mg/L respectively.

WE142 Reproductive and maternal effects of Tamiflu metabolites in medaka (Oryzias latipes) J. Li, Department of Biomedical Science, College of Science, University of Benin / Animal and Environmental Biology, Dr. M. Olu, University of Benin / Laboratory of Ecotoxicology and Environmental Forensics, Faculty of Life Sciences, Department of Animal and Environmental Biology, University of Benin, Nigeria; A. Muhib, University of Benin Benin City / Department of Environmental Management and Toxicology

The study was to assess the reproductive effect of medaka (Oryzias latipes) under chronic exposure to Tamiflu metabolite. This study carried out the 56th life stage of Africa Cat Fish Clarias gariepinus using OECD 210 guideline. Acetaminophen was 800, 700, 594.5 and 358.80mg/L respectively.

WE143 Earthworms (Eisenia fetida) response to chronic exposure to triclosan J. Zalauskaitė, Vytautas Magnus University / Department of Environmental Sciences; D. Mitsikelytė, Vytautas Magnus University / Department of Environmental Sciences; T. Paliukaitė, Vytautas Magnus University / Department of Environmental Sciences

triclosan (TCS) is a broad-spectrum and anti-fungal agent extensively used in industrial, household and personal care products. TCS widespread use has resulted in its introduction into environment and it has already been detected in surface waters, sediments, soil, living organisms and humans as well. The aim of the present study was to determine the response of Eisenia fetida earthworms to chronic triclosan exposure. Earthworms E. fetida were exposed to 10-750 mg kg⁻¹ of triclosan in soil for 56 days. The impact of survival, growth rate, reproduction and antioxidative system was evaluated. TCS severely reduced the growth rate of E. fetida and reproduction. Chronic exposure to TCS in the soil induced a significant increase in the activity of antioxidative enzymes and malondialdehyde concentration.

WE144 Predicting the fate of pharmaceuticals during wastewater treatment and crop irrigation with reclaimed wastewater M. González García, C. Fernández-López, UCAM; F. Polesel, Technical
University of Denmark (DTU) / DTU Environment; S. Trapp, Technical University of Denmark DTU / DTU Environment
Wastewater represents an alternative option for use in urban areas, industry and, especially, agriculture. Pharmaceuticals may undergo incomplete elimination in wastewater treatment plants (WWTPs) and are found in reclaimed wastewater, possibly being uptaken in crops following wastewater irrigation. Among commonly consumed crops, vegetables present the highest contamination due to past and current soil uses. In this study, we investigated the fate of pharmaceutical compounds in a wastewater treatment plant (WWTP) equipped for the elimination of carbon and nutrients. The primary treatment consists of a screen, an aerated beam extraction tank and a primary clarifier. The biologically treated wastewater from the conventional activated sludge is filtered through a continuously operating sand filter prior to being disinfected by ultraviolet radiation. Effluents are used for irrigation in agriculture. We used the simulation tool “Activity SimpleTreat - fate model for ionics in wastewater treatment plants” [1] to predict the fate of pharmaceutical compounds in the municipal WWTP. Model parameters were adapted to the situation at site. Chemical data were estimated using ACD/Labs. Model predictions were verified with measurements from a monitoring campaign in the WWTP. Results showed a high measured removal efficiency of Diclofenac, Ibuprofen and Ketoprofen concentrations in the WWTP and the simulation tool confirmed the same conclusion. As to uptake in lettuce, empirical results were compared to simulation outcome. For plant uptake prediction, a new steady-state model with translocation and phloem flow was applied [2]. Addition of phloem transport was necessary because the investigated compounds include weak acids (pKa 4 to 5), sucrose, and polyphenols and fruit. This prediction is in contrast to the alkaline phloem fluid (pH 8). The preliminary results with the new steady-state model, showed the uptake capacity of pharmaceuticals in different tissues of lettuce. The assimilation and distribution of pharmaceuticals compounds in the edible part of the lettuce leaves and the subsequent passage to the harvested plant parts is investigated. [1] Franco A. 2011. Activity SimpleTreat - fate model for ionics in wastewater treatment plants, homepage.env.dtu.dk/stt/Homepage%20and/Website.htm [2] Trapp S. 2017. New release dynamic (numeric) coupled soil-plant uptake model for monovalent ionics, homepage.env.dtu.dk/stt/2017Release_Plant_Model/index.htm

WE145 Exposure Assessment of Residual Organochlorine Pesticides (OCPs) in Orchard Soils and Fruits in Korea
B. Park, RDA / Chemical Safety; S. Lim, National Institute of Agricultural Sciences; G. Choi, National Institute for Agricultural Science; R. S. Ryu, RDA, International Institute Science, RDA
Residual organochlorine pesticides (OCPs), are chemical substances that are resistant to environmental degradation chemical, biological and photolytic process, and are bioaccumulated with potential significant impacts on human health and the environment. OCPs were designated as persistent organic pollutants (POPs) by the international community at the Stockholm Convention on Persistent Organic Pollutant. This study was conducted to investigate the OCPs residue in orchard soil and grape, peach, apple, and pear. Recovery and limit of detection (LOD) of OCPs in orchard soils and fruits were 74.4±115.6 and 74.7±92.4%, 0.04-0.08 and 0.2-0.4 µg/kg, respectively. The precision was reliable since RSD percent of LOD was 48.0, and 2.3% for DDT, 4,4-DDD and 4,4-DDD. The residue of OCPs in orchard soils was analyzed by the developed method, and endosulfan sulfate, 2,4-DDT, 4,4-DDT, 4,4-DDD, and 4,4-DDE were detected at 1.3–444.9, 2.2–31.9, 4.5–863.1, 1.9–48.0, and 2.3–119.3 µg/kg, respectively. But OCPs in grape, peach, apple, and pear were not detected in all samples. These results showed that the residue in orchard soil were lower level than bioaccumulation occurring.

WE146 PhytoCOTE project: Assessment of organic and inorganic contamination in vineyard soils
M. Schilling, LPTC / EPON UMR5805; J. Guillard, Université de Bordeaux / EPON UMR 5805; M. Davier, Université de Bordeaux / LPTC / UMR 5805 CNRS; L. Denaxa, INRA BORDEAUX; H. Budzinski, University of Bordeaux Viticulture is one of the agricultural crops that uses the most important quantities of pesticides in France, in particular fungicides. These regular inputs are adapted with air for 1 hour ZnCl2 (density of 1.7 g/cm3). After 2 days the valve in the top chamber was closed and ZnCl2 was drained so the top chamber could be removed. The fluid from the top chamber was filtrated over a 10 µm steel mesh. The device was refilled with ZnCl2 and the agitation sequence was repeated. To remove the organic fraction a gravimetrical separation was used. For a sample of this size a custom made aerator-device was built. The sample was homogenized with a high pressure homogenizer in order to improve the knowledge about the evolution in time and scale of different chemical contaminants within different soil types, a state of contamination level in soil surfaces and a characterisation of trace element availability were assessed. 53 plots with important pedological diversity were sampled over the 0-15 cm horizon. The soils were characterised (organic matter, Fe and Al oxhydroxides, CEC, granulometry, pH) and total copper, cadmium, lead, zinc and 205 organic molecules were measured. The characterisation of trace element availability was performed using passive samplers (Diffusive Gradients in Thin films). A copper contamination due to past and current uses of Bordeaux mixture (copper sulphate) has been put in evidence on the experimental site (until 197 mg/kg of dry soil). Concerning organic pesticides, a high diversity of molecules at different levels of concentration were found depending on crops. The results of the analyses will allow to show if: (1) the copper contamination level plays a role on the molecule degradation and contamination level; (2) the soil physical and chemical parameters play a role on the molecule degradation and on the copper and molecule retention; (3) the past and current soil uses impact the contamination levels.

WE147 Analysis and Assessment of Organic Contaminants in Materials Spread on Land in Scotland
E. Stuart, WCA Environment Limited; I. Wilson, G. Merrington, UK Environmental Protection Agency
Viticulture is one of the agricultural crops that uses the most important quantities of pesticides in France, in particular fungicides. These regular inputs may lead to a contamination of ecosystems and thereby affect fauna and flora. Due to improvements in analytical capability increasing numbers of synthetic chemicals are being found in organic materials that may be recycled to agricultural land such as sewage sludge, animal manures, compost and digestate. Commonly occurring contaminants include pharmaceuticals, veterinary medicines, personal care products and persistent organic pollutants. Application of suitable organic materials to land is an attractive and apparently sustainable option that offers a range of agronomic and environmental benefits. However, there is a balance to be struck between the benefits of application to land and potential risks, such as the possibility of human and environmental health effects from trace constituents. It is critical that thought of consideration of this exposure pathway and any resulting regulatory decisions are risk-based and made using robust evidence and science. Previous assessments of risks posed by contaminants in materials applied to land generally have severe limitations. However, A. Vianello, several, such as sewage sludge, have not been made for the material directly prior to application to land and the assessments often have to make use of data from a different geographical locations and regulatory jurisdictions with mismatches in chemicals management policy. This project is seeking to address these issues on behalf of the Scottish Environmental Protection Agency by undertaking representative sampling and analysis for priority organic contaminants in a range of different organic materials that are frequently spread on land in Scotland. As a large number of organic compounds (in excess of 200) have now been identified in materials that are applied to agricultural land the first phase of this project has been to undertake a risk screening exercise. The purpose of this has been to identify organic chemicals likely to persist and/or bioaccumulate and to prioritise substances that are considered to pose a risk to human health or the terrestrial environment under reasonable worst-case assumptions for spreading. Results will be presented from the analysis of priority chemicals in organic materials prior to spreading and the data will be used to undertake a refined risk assessment and to calculate a maximum safe spread rate for each material considered for application to land.

Aknowledgement - The authors thank the Scottish Environmental Protection Agency (SEPA) for funding this work

WE148 Microplastics in Agriculture Soil.
K.B. Olsen, Aalborg University / Department of Civil Engineering; N. van Aalst, Aalborg University / Civil Engineering Department; A. Hylton, Aalborg University / Civil Engineering Department
Microplastic is an environmental pollutant of worldwide concern. However, neither microplastic concentrations nor their sources or sinks are completely known. In order to understand this, a systematic approach was developed. For example, a new method “Activity SimpleTreat” for monovalent ionics, was developed. The authors thank the Scottish Environmental Protection Agency (SEPA) for funding this work.

Disclaimer: Science and Engineering remains an ongoing, collabartively managed, open source initiative that supports and empowers collaborations. This is an open-source project without any paid contributions.
ZnCl₂ solution. All floating particles were collected and individually analysed under a light microscope. Selected particles looking like plastic was analysed on the ATR.

WE149 Novel Analytical Strategies for Anthropogenic Compounds in Plants: Vegetable Biomonitoring for Substances of Environmental Concern
R. Wahman, J. Grassmann, Technical University of Munich; P. Schroeder, Helmholtz Zentrum München / Microbe Plant Interactions; S. Bieber, Technical University of Munich / Chair of Urban Water Systems Engineering; T. Letzel, Technical University of Munich

Plants play an important role in the maintenance of life. Besides providing us with food, plants are also capable of cleaning the environment, e.g. by water, i.e. from compounds like diclofenac, which occur in waterbodies in concentrations up to µg/L levels. The assimilated compounds are not excreted by the plants but stored in vacuoles. This project will focus on whether plants can eliminate pollutants from the environment and whether plants are capable of metabolizing the pollutants and to detoxify them.

These two points already have been partially clarified in phytoremediation research. However, a major problem related to this kind of research is not concerning the plant metabolism pathways, although knowledge about those pathways, the involved enzymes and the resulting transformation products is essential. Thus, our major goal was to figure out whether the biological degradation pathways can be reflected by the analytical data obtained from polarity extended RPLC-HILIC-MS analysis. There are several important research fields which give an original contribution to investigating the bond between plant metabolic pathways and soil organic carbon. This study aims to contribute to this growing area of research by exploring new or modified secondary metabolites that appear after addition of pollutants. To the best of the authors’ knowledge, no research is available up to now that surveyed the changes in the plant metabolite pathways of constructed wetland plants (CWP).

Moreover, along with growth in CWP, due to possibly accumulated contaminants the soil, an increasing concern about how these plants must be treated further, i.e. which points have to be considered regarding their disposal. We will provide a conceptual theoretical framework based on analysis of different plant extracts before and after exposure to different pollutants using novel polarity RPLC-HILIC/ToF-MS technique. The plants were exposed in the laboratory to different pollutants. Initially, the prevalent diclofenac was chosen. After the plants reached their maturity, they were exposed to pollutants for a few days. To establish the concept at the beginning comparably high concentrations of pollutants were applied. Finally, we will be able to provide an open access database of plant metabolites (PHRAGMITES-IDENT) and implement it into an analytical platform constructed earlier (FOR-IDENT; see https://water.for-ident.org). This work is supported by the Bavarian State Ministry of the Environment and Consumer Protection.

WE150 Pharmaceuticals uptake by spinach from seven soils mixed with sewage sludge
R. Kodesova, A. Klement, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; O. Golovko, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses; A. Nikodem, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; O. Koba, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses; M. Fer, Czech University of Life Sciences Prague / Dept of Soil Science and Soil Protection; R. Grabic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses

This study was focused on a mobility of pharmaceuticals from sewage sludge in soils and their uptake by plants. Soil samples were taken from top horizons of seven different soil types (Stagnic Chernozem Silte, Haplic Chernozem, Gleyic Phaeozem, Haplic Lavisol, Arenosol Epieuritic, Haplic Cambisol, Dystric Cambisol). Sewage sludge samples were taken from two wastewater treatment plants. Two experiments were performed. a) Soils mixed with sludge were packed in plastic columns, humidified to a value close to a field water capacity and 14 days incubated under laboratory conditions. Then, a ponded infiltration was applied and cumulative water outflow and solutes discharge from the bottom were measured. b) Cambisol (Spinaeola oleracea L.) was planted in soils mixed with sludge packed in plastic columns under greenhouse conditions. The amount of pharmaceuticals in plant parts (i.e., roots and leaves) was evaluated after harvesting. Compounds’ discharges as well as their root uptake were soil and sludge dependent. In general, mostly larger discharges were observed form the Arenosol Epieuritic and Cambisols. Mobility of compounds depended on their sorption affinity to particular soil. The results showed that sludge containing non-sterilized SMS can increase soil pH and urease activity, and non-sterilized SMS can promote soil laccase activity. The results show that the dissipation of DEHP is accelerated after incubation with SMS for 25 d, however little effect can be found with continued incubation due to low DEHP bioavailability. In this research, SMS amendment exhibits no effect on DnBP dissipation in soils and DnBP accumulation in bok choy. It was proposed that atmospheric deposition of DnBP must be the main source of DnBP in bok choy in the study, since equivalent amounts of DnBP were detected in the vegetables grown in soils with or without DnBP spiking. This study indicates that the application of SMS as an organic fertilizer is less likely to affect the fate of PAEs in soils, and proper strategies should be conducted to reduce PAE levels in atmosphere to control PAE contamination in vegetables.

Plants: predicting and assessing direct, indirect effects and recovery of plants from chemical stress (P)

WE152 Experiences of demonstrating aquatic plant recovery following herbicide exposure using sloped mesocosms
F. Pickering, Cambridge Environmental Assessments

Recovery is important when considering short term exposure of aquatic non-target plants to herbicides in edge of field water bodies. Mesocosms studies allow the effects on both individual species and communities to be assessed simultaneously. Unlike indoor laboratory studies, where test item concentrations are artificially maintained, mesocosms studies allow for a more realistic application and dissipation of test item. Therefore, mesocosms studies can assess direct and indirect effects whilst a test item is present, and also monitor the period after dissipation has occurred to assess possible recovery. Using our sloped mesocosms at Cambridge Environmental Assessments (CEA), we are successfully able to test up to ten macrophyte species, each with different physical structures and characteristics (e.g. rooted; emergent). Some traditional measures of plant health can be seen as subjective (e.g. necrosis scoring and macrophyte mapping). At CEA, additional metric parameters such as number of nodes, number of leaves and stem lengths are routinely measured throughout the in-life phase. As a result, a combination of parameters are measured for each species tested. This ensures that the endpoints of a study are suitably robust and can be used to assess recovery. Here we will discuss which endpoints are most sensitive, reliable and therefore most suitable for determining effects on each plant species. Finally we will discuss which of these measurements are most relevant to assess recovery.

WE153 Impact of plant density on the end points (ER50) determined for crop protection products in Non Target Terrestrial Plants Studies conducted to OECD 227, Vegetative Vigour
E. Paterson, A. Thompson, Dow AgroSciences; G. Mercealli, Dow AgroSciences Italia s.r.l. / Ecostoxikologie; K. Ralston-Hooper, Dow AgroSciences; G. Karaiskou, AgroSciences Non Target Terrestrial Plant (NTTP) studies conducted to OECD 227 test guidelines are submitted as part of the registration process for plant protection products in Europe and the US. Current planting densities described in OECD test guideline 227 for Vegetative Vigour Studies, recommends 1-2 large plants per 15 cm³ volume for medium size species per 15 cm pot and 5-10 small species per 15 cm pot. The minimum recommended number of plants per treatment in OECD 227 is 20, as a result vegetative vigour studies conducted to this guideline, regularly exceed 750 pots. These studies require a large amount of glasshouse space and are very labour extensive. Establishing, spraying, assessing and handling data from such large studies has its own issues and can increase the probability of errors occurring during the study design phase when the study can be conducted in a given time frame; and increasing plant variability within the study making data interpretation more difficult. OECD 227 is a guideline and different planting densities, which are considered adequate to generate robust data, may be used. However it needs to be assessed whether these different planting densities in the pots can impact the final endpoints determined in the Vegetative Vigour studies and ultimately the risk assessment. Data will be presented to discuss which endpoints can be assessed at different planting densities to evaluate any impact on the Vegetative Vigour Study endpoints (expressed as ER50 values) used in the risk assessment.
WE154
Interspecific competition impact on organism responses to chemical stress: an SSD-based approach.
V. BAILLARD, LIEC (CNRS UMR 7360, Université de Lorraine); C. SULMON, ECOBIO; CNRS UMR 6553, Université de Rennes 1 / UMR CNRS ECObio; A. BIOT, LIEC (CNRS UMR 7360, Université de Lorraine); A. MONY, ECOBIO; CNRS UMR 6553, Université de Rennes 1; S. Devia, LIEC, CNRS UMR 7360, Université de Lorraine / LIEC, CNRS; E. Billoir, Université de Lorraine, CNRS UMR 7360
Organisms are not alone in the environment. They interact with other individuals of same or other species in different ways. Interspecific competition is an important interaction for herbaceous plants in grass strips. Such vegetated areas generally act as buffer strips against pollutant flows and are thus submitted to various chemical exposures. However, competition is rarely considered in environmental risk assessment. To address this point, we tested whether competition modifies the way plants respond to herbicide (isoproturon) toxicity in an attempt to link individual tolerance of organisms and community dynamics. Then we investigated the impact of competition on species sensitivity distribution (SSD), a widely used community-level risk assessment tool that usually considers monospecific bioassays only. To do so, we exposed during 25 days 6 herbaceous species (representing varied isoproturon tolerance and competition ability) to 6 isoproturon concentrations (0 to 1.75µM) in presence and absence of a selected competitor, Bromus erectus (choice based on its high resistance to isoproturon and its high competition ability). For each species and concentration, 10 different traits corresponding to morphological, biomass and physiological responses, as well as the response profile of 50 metabolites were quantified for aerial and underground plant parts, then representing respectively soft (easy to acquire) and hard traits. The consequent dataset generated was used to model plant responses depending on isoproturon concentration and competitor presence/abscence. For soft traits, dose-responses curves were built for each species, in presence and absence of competitor for each endpoint to define (1) their sensitivity, (2) their relevance to assess toxicity, (3) how competition modify points (1) and (2). In parallel, metabolomic data were treated the same way, using a workflow created to handle high-throughput dose-response datasets from omics experiments. We then calculated toxicity values and built SSDs with and without competitor presence in an attempt to quantify competition effects compared to competitor-free ecotoxicological data. A final experiment, involving a complex assembly of the same 6 species under various isoproturon exposures was carried out to assess our model validity using community scale data.

WE155
How to consider recovery of aquatic plants in risk assessment?
U. Hommen, Fraunhofer IME; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; H. Krueger, EAG Laboratories
Exposure of non-target plants to plant protection products or other stressors can be restricted in time. For each endpoint, short replicates were, e.g. by degree exposures or days. For long-term experiments, 10 different traits corresponding to morphological, biomass and physiological responses, as well as the response profile of 50 metabolites were quantified for aerial and underground plant parts, then representing respectively soft (easy to acquire) and hard traits. The consequent dataset generated was used to model plant responses depending on isoproturon concentration and competitor presence/abscence. For soft traits, dose-responses curves were built for each species, in presence and absence of competitor for each endpoint to define (1) their sensitivity, (2) their relevance to assess toxicity, (3) how competition modify points (1) and (2). In parallel, metabolomic data were treated the same way, using a workflow created to handle high-throughput dose-response datasets from omics experiments. We then calculated toxicity values and built SSDs with and without competitor presence in an attempt to quantify competition effects compared to competitor-free ecotoxicological data. A final experiment, involving a complex assembly of the same 6 species under various isoproturon exposures was carried out to assess our model validity using community scale data.

WE156
Rimsulfuron toxicity and recovery in duckweed (Lemna minor)
M. Opincarn, University of Florida / School of Natural Resources and Environment; P.C. Wilson, Z. Li, University of Florida / IFAS / Soil and Water Science
Rimsulfuron is an herbicide for which very little is known about its toxicity to aquatic macrophytes. This study was designed to evaluate the effects of rimsulfuron on the model aquatic macrophyte Lemna minor at low concentrations. This study also evaluated recovery by L.minor following a 5 day exposure period. Growth rates were measured at 1, 3, and 5 days following exposure to rimsulfuron-fortified 10% Hoaglands media at concentrations of 0, 0.0003, 0.0006, 0.00125, 0.0025, 0.005, 0.01, and 0.02 mg/L. After 5 days exposure, growth rates were significantly lower for rimsulfuron concentrations >0.006 mg/L. Following the 5-day exposure period, plants were rinsed with deionized water and placed in fresh Hoagland’s nutrient media. Impact on growth rate was measured as percent impact compared with growth of the control. Growth rates for 00006 mg/L were reduced 25.4% relative to the controls. Interestingly, a horometic response was observed at the 0.003 mg/L treatment concentration. In this case, the growth rate was 16.7% relative to the control. Following exposure, significant reductions in growth rate were observed on days 3, 5, and 10. However, 15 days after removal from the rimsulfuron treatment solutions, growth rates recovered to control levels. While rimsulfuron exposure significantly reduced growth rates of L.minor at all concentrations >0.0006 mg/L, effects were found to be reversible. Rimsulfuron was fast acting, with toxicity observed 1 day following exposure. In contrast, a longer period of time was required for growth rates to recover to control levels.

WE157
Toxicokinetic/toxicodynamic (TK/TD) modelling - Increasing the realism in risk assessments for aquatic plants
S. Hane, Bayer AG / Effect modelling; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; A. Solga, Bayer AG; T. Preuss, Bayer AG / Environmental Safety
For assessing the risk of plant protection products (PPP) to aquatic ecosystems, environmental concentrations of the active substance need to be estimated. Throughout Europe different approaches are used to predict these environmental concentrations. To characterize the risk effect on a plant species, ecotoxicological thresholds derived from experiments with constant exposure to an active substance over several days are compared to the predicted maximum environmental concentration. Although, it can be deemed conservative to only consider the maximum concentration, there are plenty of cases where the risk assessment becomes overly conservative due to this practice. This applies particularly to aquatic ecosystems where exposure to active substances usually last for a few hours or days, only. Since some models for the prediction of environmental concentrations do not only deliver maximum concentrations but also temporally explicit exposure (patterns), a more detailed and realistic assessment of exposure is possible. To also increase the realism on the effect side, either an ecotoxicological threshold from a refined exposure experiment is needed, or the effect of the predicted exposure pattern on the organism is investigated by ecological modelling. We propose TK/TD modelling as a powerful tool to evaluate effects of time variable exposure on aquatic plants. TK/TD modelling refers to linking effects to the internal concentrations in an organism instead of the external one and by this being able to consider time-variable dose exposure patterns. For characterizing risks of active substances by TK/TD modelling, it is necessary to adjust the approach to a specific substance. Adjusting in this context means defining TK/TD parameters to describe the uptake/elimination and the internal dose-response relationship. Besides defining the parameters, it is also necessary to validate them by using the parameterized TK/TD model and by comparing predictions of the model to measured data. In this work we present a workflow created to handle high-throughput dose-exposure datasets from omics experiments. We then calculated toxicity values and built SSDs with and without competitor presence in an attempt to quantify competition effects compared to competitor-free ecotoxicological data. A final experiment, involving a complex assembly of the same 6 species under various isoproturon exposures was carried out to assess our model validity using community scale data.

WE158
Assessing soil toxicity of methylparaben using plants and collembola
D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science
Methylparaben is an endocrine disrupting chemicals (EDCs) and is contained in personal care products such as cosmetics and quasi-drugs. Methylparaben is known to have low toxicity to mammals, but there is no data on hazard assessment for soil ecosystems. Methylparaben was mostly removed in the sewage treatment process, but was detected in soils of various countries. In addition, there is a possibility that personal care products may leak into aquatic or soil environments if they are not disposed of properly. Therefore, it is necessary to evaluate the hazard assessment of methylparaben in soil ecosystem. This study assessed the toxicity of methylparaben to plants (mung bean and rice) and collembola. Plants were exposed methylparaben from 0 to 400 mg/kg for 14 and 21 days. In plant toxicity tests, shoot and root growth, root development, stomatal opening size, chlorophyll contents and photosynthetic factors were measured. In the collembola test, methylparaben was exposed at 0 to 500 mg/kg for 5 days and mortality was observed. The most sensitive endpoint in mung bean was identified as stomatal opening size, and no-observed effect concentration (NOEC) was 10 mg/kg. The most sensitive factor in rice was chlorophyll contents, and NOEC was under 10 mg/kg. The half-lethal concentration (LC50) value for collembola was 440.53 mg/kg. Methylparaben appears to have significant physiological effects on plants even at low concentrations. The results of this study can be fundamental for soil risk assessments of methylparaben. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and the Graduate School of Specialization for 363

SETAC Europe 28th Annual Meeting Abstract Book
Managing information related to chemical risk.

**WE159** Evaluation of phytotoxicity for Bisphenol A with new endpoint, phytoestrogen

D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

The endpoints for the chemicals (EDCs) are known as chemicals that show hormone-like action or inhibit hormones, the phytotoxicity assessment of EDCs does not have any specific toxic endpoints for these substances. The factors (growth, photosynthetic activity, chlorophyll, etc.) used to evaluate common toxic substances such as heavy metals are also applied to EDCs. These factors are not suitable for EDC materials, which have relatively low toxicity to organisms, and produce the most sensitive strains (3.37 mg/L), followed by the most sensitive strain (3.37 mg/L), and the most sensitive strain (3.37 mg/L) followed by the most sensitive strain (3.37 mg/L). Meanwhile, bisphenol A is known as a representative EDC used in the production of consumer products and in various industrial fields. While it is used widely for various purposes, the toxic ecotoxicity of bisphenol A is limited. Therefore, we evaluated the toxicity of bisphenol A (75 mg/L) in the presence of various isolates (such as Agrobacterium tumefaciens). In addition, DEHP and nonylphenol are likely to release into the soil environments, soil ecotoxicity data are currently limited. Ecotoxicological researches in soil were reported in only three cases of DEHP and four cases of nonylphenol. This study was conducted to evaluate the effects of DEHP and nonylphenol on the growth and physiological changes of mung bean and rice. The toxicity tests were conducted on 14 days (acute) and 21 days (chronic). Shoot growth was measured in 14 days-acute experiment and physiological factors including stomata opening size, chlorophyll content, and photosynthetic activity were evaluated in the 21 day-chronic experiment. This study is meaningful because the toxic ecotoxicity of the two substances to the plants was conducted using various factors, and the results of this study can be fundamental for soil risk assessments of DEHP and nonylphenol. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and the Graduate School of Specialization for managing information related to chemical risk.

**WE160** Soil toxicity of DEHP and Nonylphenol on mungbean and rice

D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

DEHP is used as a plasticizer and insecticide. Especially, it can be used as plastic vinyl applied in farmland. Nonylphenol is used as surfactant, and 4-nonylphenol is mainly used in various substances such as insecticide and detergent. Although DEHP and nonylphenol are likely to release into the soil environments, soil ecotoxicity data are currently limited. Ecotoxicological researches in soil were reported in only three cases of DEHP and four cases of nonylphenol. This study was conducted to evaluate the effects of DEHP and nonylphenol on the growth and physiological changes of mung bean and rice. The toxicity tests were conducted on 14 days (acute) and 21 days (chronic). Shoot growth was measured in 14 days-acute experiment and physiological factors including stomata opening size, chlorophyll content, and photosynthetic activity were evaluated in the 21 day-chronic experiment. This study is meaningful because the toxic ecotoxicity of the two substances to the plants was conducted using various factors, and the results of this study can be fundamental for soil risk assessments of DEHP and nonylphenol. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and the Graduate School of Specialization for managing information related to chemical risk.

**WE161** Toxicity of a glyphosate based formulation on phytoplanktonic green microalgae

J.G. Perez, Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales / Departamento de Biodiversidad y Biología Experimental, Buenos Aires; A. Magdaleno, Universidad de Buenos Aires / Facultad de Farmacia y Bioquímica, Cátedra de Salud Pública e Higiene Ambiental; M.d. Rios de Molina, Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales / Departamento de Química Biológica, CONICET-UBA, Instituto de Química Biológica - Ciencias Exactas y Naturales (IQUIBICEN); A.B. Juarez, Universidad de Buenos Aires / Facultad de Ciencias Exactas y Naturales, Departamento de Biodiversidad y Biología Experimental

The emergence of transgenic crops led to an increase in the use of glyphosate and its presence in different ecosystems is a worldwide problem. Although it was designed to inhibit the aromatic amino acids synthesis in plants, glyphosate exerts toxic effects on non-target organisms, probably through other mechanisms. Its entry into waterbodies is a risk for biota, particularly for the phytoplankton microalgae communities that compose the aquatic food webs. In this work the effects of a glyphosate formulation (44% monopotassium salt of N-phosphonomethyl glycine) on the growth, chlorophyll content and oxidative stress parameters of 3 phytoplanktonic green microalgae were evaluated. Cultures of *Senedesmus acutus*, *Ankistrodesmus fuciformis*, *Monoraphidium contortum* and *Parachlorella kessleri* were exposed to increasing glyphosate concentrations (0 - 75 mg glyphosate/L) and kept at 24 ± 1 °C, under continuous agitation and illumination. After 96 h, growth, IC50, chlorophyll a content and oxidative stress parameters were evaluated. The glyphosate caused a significant decrease of chlorophyll a in *M. contortum* and *P. kessleri*, but not in the other two species tested. The growth of the 4 strains was negatively affected and regarding the IC50 values *M. contortum* was the most sensitive strain (3.37 mg/L), followed by *A. fuciformis* (6.50 mg/L), *S. acutus* (14.74 mg/L) and *P. kessleri* (41.75 mg/L). In order to evaluate the relationship between antioxidant defenses and sensitivity, we analyzed parameters of oxidative stress in the least and the most sensitive strains. The exposition to 2-4 mg glyphosate/L in *M. contortum* and 30-75 mg glyphosate/L in *P. kessleri*, caused increases of reactive oxygen species, lipid peroxidation (TBARS), reduced glutathione, superoxide dismutase, and glutathione transferase. The level reached of TBARS in *P. kessleri* was 10 times lower than in *M. contortum*, while the levels of antioxidant defenses were 3.5 - 7 times higher. These results suggest that oxidative stress would be involved in the toxicity of the glyphosate formulation and that the differences in sensitivity between strains could be due to differences in their defense antioxidant levels. According to the EU Directive 93/67/EEC, the IC50 values estimated indicate that the glyphosate formulation assayed should be toxic for aquatic biota. Besides, results also warn about its possible effects on the composition of phytoplankton, which would put at risk the balance of the aquatic ecosystem.

**WE162** Indicator, indigenous and invasive species: the need of risk-benefit considerations in PPP risk assessment

G. Messergi, Dow AgroSciences Italia s.r.l. / Ecotoxicology; C. Vaj, V. Zaffagnini, A. Carone, Dow AgroSciences Italia srl

Indicator species are the basis of the ecological risk assessment framework. Endpoints derived for these species are used in the risk assessment to evaluate the safety of, e.g. plant protection products (PPP) to non-target species. In certain cases indicator species are also indigenous species to a particular region (e.g. *Myriophyllum spicatum* in Europe). Invasive species are non-autochthonous species, accidentally introduced in a given region, which, in absence of their natural predators, often grow uncontrolled and overcome indigenous species, completely devastating the biodiversity of the habitats they colonize. The uncontrolled growth of these species can be also a threat to ecosystem functioning, e.g. altering oxygen balance in the case of the aquatic environment or shifting the prey/predator equilibrium. In cases where other control means are not possible, PPP could be employed to control the spread of invasive species. As an example, in the USA some herbicides have been authorised to control *M. spicatum*, which is an invasive alien species in North America. On the other hand, recently in Europe there have been reports of *Myriophyllum aquaticum*, a new alien invasive species genetically related to the indicator *M. spicatum*. In Piedmont (Italy), *M. aquaticum* has been observed in the Po River, threatening aquatic biodiversity. In addition also rice cultivation, a very important crop for the region, is at risk, due to the uncontrolled growth of *M. aquaticum* in canals and ditches feeding water to rice paddies. This species has been added as an invasive species to the black lists of Piedmont and of the European Union and it is being monitored and controlled with local initiatives. To prevent the irreversible degradation or destruction of natural habitats by non-autochthonous species, a timely intervention may be necessary, even if this may result in a temporal impact on indigenous desirable species. Programs to control invasive species to restore degraded by the presence of alien species. The use of a risk-benefit analysis, which can help in the decision of whether PPP are suitable for use in such programs, will be discussed in light of the two abovementioned examples.

**WE163** Auxinic herbicides: the impact of water plants’ root measurements on the risk assessment

G. Genson, Eurofins Agrosciences Services Ecotoxic GmbH

Data requirements for the registration of plant protection products in the EU Regulation 1107/2009 indicate that a test on a *Myriophyllum species* is necessary for auxinic herbicides. The OECD 239 water sediment test with *Myriophyllum spicatum* was developed to test autochthonous species (North America). On the other hand, recently in Europe there have been reports of *Myriophyllum aquaticum*, a new alien invasive species genetically related to the *M. spicatum*. In Piedmont (Italy), *M. aquaticum* has been observed in the Po River, threatening aquatic biodiversity. In addition also rice cultivation, a very important crop for the region, is at risk, due to the uncontrolled growth of *M. aquaticum* in canals and ditches feeding water to rice paddies. This species has been added as an invasive species to the black lists of Piedmont and of the European Union and it is being monitored and controlled with local initiatives. To prevent the irreversible degradation or destruction of natural habitats by non-autochthonous species, a timely intervention may be necessary, even if this may result in a temporal impact on indigenous desirable species. Programs to control invasive species to restore degraded by the presence of alien species. The use of a risk-benefit analysis, which can help in the decision of whether PPP are suitable for use in such programs, will be discussed in light of the two abovementioned examples.

**WE164** Testing the emergent macrophyte, Glyceria maxima in a water-sediment system: Results of a ring-test with Isoproturon

J. Davies, Syngenta / Environmental Safety; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; K. Kuhl, Bayer AG - Crop Science Division; J. Kubritza, BASF, M. Ratte, ToxRat Solutions GmbH & Co. KG

Under EU pesticide regulation, regulatory tests are required for the aquatic macrophyte, Lemna, and two algal species for herbicides and plant growth regulators. Data requirements introduced under EU Directive 1107/2009 stipulate that further tests may be required for compounds which show selectively higher toxicity to either dicotyledonous or monocotyledonous plant species in terrestrial plant tests. In these cases, the recommended dicot and monocot species
are Myriophyllum and Glyceria, respectively. OECD Test Guideline 239 for testing Myriophyllum spicatum in a water-sediment system was adopted in September 2014 and this test method has since been adapted to facilitate growth of the emergent, reed grass, Glyceria maxima. During 2016 and 2017, 15 laboratories participated in a ring-test with the herbicide, isoproturon against Glyceria. The objectives of this test were to establish standard plant culture protocols, to determine the required test duration, to characterize control variability and inform test design and to identify appropriate validity criteria. Results of this ring-test will be presented alongside progress on a second ring-test with the herbicide imazapyr, scheduled for Spring / Summer 2018.

WE165 Study of the toxicity effects of Cd, Ni and Zn on macrophytes, antioxidant responses and time for steady-state bioaccumulation under constant metal concentrations exposures

S. Martinez, CONICET PRIET UNLU; M. Saenz, PRIET CONICET, National University of Luján; W. D. Di Marzio, CONICET-PRIET / PRIET

Heavy metals represent an actual environmental problem because the industrial and commercial uses of them are continuously increasing, bringing on a widespread contamination. Examples of human activities that contribute in heavy metal contamination are mining, smelting, fossil fuel combustion and industrial applications. Human activities may also indirectly cause changes in the environment that mobilize metals that were otherwise bound in stable forms, making them bioavailable. Aquatic bodies directly or indirectly receive pollutant discharges and metals, in watercourses and are easily absorbed by organisms. This study was aimed to evaluate the individual toxicity effect of Cd, Ni and Zn on a macrophyte and its bioaccumulation capability. Cadmium is a hazardous environmental pollutant and is toxic to most organisms. Nickel and Zinc are essential trace elements needed in the nutrition of plants. Nevertheless, over certain threshold they can present phytotoxic activity. Macrophytes are key elements in aquatic ecosystems and watercourses and are considered as Thalassia, C. W. Martinez, CONICET PRIET UNLU; C. Wang, C. Carranza, Universidad Autonoma de San Luis Potosi / Laboratorio de ciencias ambientales; A. J. Alonso, Universidad de Guanajuato / Departamento de Farmacia

Understanding the physiology of T. praecox exposed to Ni and its’ Ni tolerance limits might be relevant for the potential application of this species in phytostabilization or phytorextraction technologies at contaminated soils.

WE167 Phytorextraction of heavy metals in Cienega of Tamasopo wetland, México, by Typha latifolia

A. Drozdov, A. Pacheco, M. Saenz, PRIET CONICET, National University of Luján; C. Lagardera, CONICET PRIET / PRIET

Heavy metals are persistent inorganic toxic pollutants that come from diverse anthropogenic activities [1]. They can be easily absorbed by the roots of plants due to their relatively high mobility in the soil. Aquatic plant species are known to have great importance, forming a substantial component of the primary production in many aquatic ecosystems, especially in wetlands. Plants can remove and accumulate metals from the solution by phytorextraction; however, the metals can also be precipitated or eliminated from the solution by ion exchange or by adsorption on organic and inorganic compounds. Concentrations of heavy metals in aquatic plants depend both on metal speciation and on the species of plant absorbing the metal [2]. High concentrations of some trace metals in aquatic plants have led many authors to believe that they accumulate from water and/or sediments; the uptake is influenced by several factors, such as temperature, pH, light and the presence of other metals in the water, all of which alter the uptake of heavy metals into the tissue [3]. Metal uptake by plants has three patterns:[1] true exclusion in which metals are re-released from entering the plants; [2] shoot exclusion, in which metals are accumulated in the root but translocation to the shoot is restricted; and [3] accumulation, where metals are concentrated in the plant parts [4]. The present research examines the phytorextraction in situ of heavy metals by Typha latifolia to determine the concentration of these metals in the plant, water and sediments. The experimental procedure consisted of: 1) sampling of five sites of the Cienega of Tamasopo wetland; 2) metal concentrations in Control; 3) samples of 5% acidified water with HNO3, and one sample without acidification for physicochemical parameters, one sample of the first 10 cm of sediment; 2) plants: washing, separation in roots and leaves and drying at 70 ºC for 18 hours in Lindberg / Blue stone; 3) grinding and spraying of root and leaves in analytical mill; 4) acid digestion with HNO3/LiCl/LiOH; 5) quantification of heavy metals by ICP-MS in digestion and water column samples. The results show that Typha latifolia accumulate Mn> Zn>Cr> Pb>Cu>A> Hg>Cd in roots. This study aimed to gain a better understanding of the importance of aquatic plants such as Typha latifolia in heavy metal accumulation and detoxification mechanisms.

WE168 Heavy metal removal by aquatic plants

M. Saenz, PRIET CONICET, National University of Luján; J. Alberdi, priet conicet unlu; s. martinez, CONICET PRIET UNLU; s. curieses, priet conicet unlu; w. d. di marzio, CONICET-PRIET / PRIET

Aquatic plant species including free floating plants can be used in direct or indirect removal of pollutants from the environment due to their toxic and phytotoxic activity. Macrophytes are key elements in aquatic ecosystems, especially in wetlands. Plants can remove and accumulate heavy metals and therefore have been exploited worldwide in the field of wastewater treatment technologies. Aquatic plant species including free floating or rooted plants can also be precipitated or eliminated from the solution by ion exchange or by adsorption on organic and inorganic compounds. The objectives of this test were material uptake rates were faster within the aquatic plant species were monitored using UHPLC/DAD/MS, while phenolics, sugars and organic acids were analyzed by AAS, while data on Ni hyperaccumulation are scarce. Our aim was to bring more phytoremediation techniques, to determine the required test duration, to characterize control variability and inform test design and to identify appropriate validity criteria. Results of this ring-test will be presented alongside progress on a second ring-test with the herbicide imazapyr, scheduled for Spring / Summer 2018.

WE166 Physiological responses of Thalaspri praecox (Brassicaeae) to Ni hyperaccumulation

T. D. Mišlenčić, K. Jakovljević, S. Jovanović, University of Belgrade / Faculty of Biology Institute of Botany and Botanical Garden Jezermovac; N. Mihailović, University of Belgrade / Institute for the Application of Nuclear Energy; V. Maksimović, University of Belgrade / Institute for Multidisciplinary Research; D. Mišić, University of Belgrade / Institute for Biological Research Sinisa Starković Thalaspri praecox is a well known heavy metal hyperaccumulating plant species. The ability of T. praecox to hyperaccumulate Zn and Cd have been extensively studied, while data on Ni hyperaccumulation are scarce. Our aim was to bring more understanding of the physiology of T. praecox exposed to increasing concentrations of Ni. Seeds of T. praecox were collected from an ultramafic site on Mt. Maljen (Serbia). Two-week-old seedlings were planted to a peat based substrate amended with increasing concentrations of Ni (250, 500, 1000 ppm). Plants were grown for 3 months under controlled conditions. Content of Ni in plants was analyzed by AAS, while phenolics, sugars and organic acids have been analyzed using UHPLC/DAD/MSS or HPLC-PAD. No visible toxicity symptoms were observed during plant growth, and Ni did not affect biomass production at applied concentrations. A dose-dependent response of T. praecox shoots to applied Ni concentrations was recorded. Ni hyperaccumulation threshold of 1000 ppm was exceeded in the shoots at all treatments, and the highest Ni content was 6786 ppm. Calculated values of translocation factor (shoot/root ratio of Ni concentration) above 10 in all Ni treated groups indicated active translocation of Ni from roots to the shoots. At the highest applied Ni concentration, statistically significant reduction of total chlorophyll content and carotenoids were observed. Contents of phenolic acids and flavonoids were generally low, and were not significantly affected by increasing Ni concentrations. Effects of increasing Ni concentrations on the content of sugars and organic acids in shoots have also been analyzed.

Understanding the physiology of T. praecox exposed to Ni and its’ Ni tolerance limits might be relevant for the potential application of this species in phytostabilization or phytorextraction technologies at contaminated soils.
WE169 Toxicity of the binary mixture Cd-Zn on Lemna gibba evaluated using morphological and oxidative stress enzyme endpoints
s. martinez, CONICET PRIET UNLU; W.D. Di Marzio, CONICET-PRIET / PRIET; M. Saenz, PRIET CONICET, National University of Luján

The presence of metals in the environment represents one of the major concerns as they are persistent in nature, non-biodegradable and can bioaccumulate in living organisms or plants. Metals in aquatic ecosystems may have toxic effects on many trophic level comprised partly by aquatic vascular plants, also called macrophytes. These organisms play a critical role in this environment. As a representative species of macrophytes, we worked with a rooted free-floating Lemna gibba. The metals evaluated here were Cd and Zn, individually and in mixtures. Exposures of plants were carried out in presence or absence of Cd and Zn for 7 days. Different endpoints were determined at the end of the assays. Number of fronds, fresh weight, fronds/colonies ratio, frond area and exes’ length were the determined morphological endpoints. Physiological changes were evaluated as enzymatic activity of catalase, ascorbate peroxidase and guaiacol peroxidase, determined at the lowest chromium concentration solutions. No EC50 was determined in order to compare the sensitivity of the different endpoints, NOEC and LOEC toxicity indexes were calculated. For Cd, fresh weight and fronds/colonies ratio resulted in the most sensitive, while for Zn total area was the most sensitive. Even though there was no significant difference for guaiacol peroxidase activity for Cd, it presented an increase compared to control. While the other enzymes had activity levels similar to the control. In the case of Zn, catalase and ascorbate peroxidase activity increase. Where higher than of both presented significative differences with it. For the mixture analysis, multiple regression was used to fit the observed %frond number inhibition (%FNI) to dissolved metal concentration (M[ coupon]). The negative value of the parameter of the interaction between Cd and Zn indicates alleviation of %FNI and toxicity. The concentration addition approach was evaluated by calculating the sum of two single-metal Toxic Unit (ΣTU) for each concentration. The results and the fitted model indicate no antagonism. All endpoints analyzed, however neither of both presented significative differences with it for the mixture analysis.

WE170 Increase of tolerance of green algae as a tool in metal bioremediation
M. Saenz, PRIET CONICET, National University of Luján; F. Cassani, S. Martinez, s. curieses, J. Alberdi, CONICET PRIET UNLU; W.D. Di Marzio, CONICET-PRIET / PRIET

Presence of various metals in aqueous streams arising from the discharge of untreated metal containing effluents into water bodies, is one of the most important environmental issue, as human health risks and harmful effect to living organisms occur. In the last decades the amount of Chromium in aquatic and terrestrial ecosystems has increased as a result of different human activities such mining, chemical production and use of wood preservatives. In order to control to evaluate the use of preadapted strains to sublethal concentrations of Chromium, into bioremediation of Chromium containing wastewater. Preliminary results will be shown related to the assessment of the potential of this strategy to increase tolerance of selected species in order to become an interesting tool in the field of bioremediation processes mediated by green algae. Two green algae species were used (C. reinhardtii and C. eugracilis). Both of them differ in its morphological structure and organization level as the former has a cenospheric feature while the second a free unicellular one. Both strains were maintained by a year under sublethal concentrations of chromium ranging from 0.42 to 73 mg/l. These concentrations were chosen base on previous experiments through range finding tests. Sublateral solutions were renewed monthly and algal cells were subcultured in new medium. After the preadaptation period, each sublateral exposed algal population from both strain and one which was never exposed to the metal, considered as the control, were centrifuged. An inoculum of know cell density was prepared with each pellet, and the algae were exposed to a wide range of Chromium concentration solutions. Samples of solution and algal cells were taken for metal determination in order to elucidate the mechanism of resistance origin. The harvested cells were centrifuged and a microwave acid digestion were carried out. Metal determinations in sublateral solutions and in algal sample were made by flame atomic absorption spectrometry. Chromium accumulation and compartmentalization in algal cells would explained the increase resistance observed. Further studies relative to detoxification mechanisms and chelating internal molecules as phytochelatin will be conducted to unravel the tolerance mechanisms involved.

WE171 Ecotoxicological assessment of the iron mining waste from Mariana (Brazil) on terrestrial flora using different plant species
O.R. Alves, University of São Paulo USP / Department of Hydraulic and Sanitation; O.A. Bandeira, T.J. Pinto, L.P. Figueiredo, University of São Paulo USP; E. Espindola, University of São Paulo USP / Hydraulics and Sanitation

In Brazil it is very common to have mining waste placed in dams, especially in the Minas Gerais state. The deposit of mining wastes implies in risk of dam rupture, between other problems. In November 2015, the rupture of the “Fundão” Dam in the city of Mariana in Minas Gerais state was one of the worst environmental disasters in Brazil. The rupture caused severe impacts to the terrestrial and aquatic environments, where tons of the waste has been placed. It is now matter of concern to study the effects of the mining waste deposition in soil to terrestrial flora in order to understand the real consequences to the environment and so be able to propose actions for restoration and management of the affected area. The main goal of this study was to evaluate the ecotoxicity of the mining waste that outpoured the Fundão dam to ten different plant species (Avena strigosa, Pennisetum glaucum, Crotalaria juncea, Canavalia ensiformis, Cajanus cajan, Cajanus cajan, Dolichos lablab, Mucuna pruriens gray, Mucuna pruriens black and Lupinus albus). The ecological and toxicological assays followed the OECD guidelines to the mixtures of a natural soil (NS) from Mariana (uncontaminated) and the waste (W). The combinations of mixtures were: P1: 75% NS and 25% W; P2: 50% NS and 50% W; P3: 25% of NT and 75% of the W and P4: 100% W. The parameters evaluated were: Fresh and dry biomass (shoot and root), height, length of the longest root and seed emergence. All species, except Lupinus albus and Avena strigosa, had EC50 and/or EC10, in at least one of the seven parameters evaluated. The species that presented 50% inhibition of root growth were C. juncea (73.07%), P. glaucom (82.68%) and C. cajan (97.54%). The height of the first two species was affected by 20% in the proportions 76.81 and 85.91%, respectively. The proportions 87.32 and 40.61% of waste affected 50% of the length of the longest root of C. juncea and P. glaucom. The results showed that: the species tested presented different indices of effect to soil fertility by mining waste; the capacity of algalic of the Eucalyptus species caused phytotoxic effects in all tested species; the most sensitive and least sensitive parameters, respectively, were root growth (root length and dry biomass) and seed emergence.

WE172 Mitigation of CuO nanoparticles microbial ecotoxicity by plant in an agricultural soil: plant variety matters
J.M. Martinez, IGE UMR 5001 / Université Grenoble-Alpes; A. Cantarel, Université Claude Bernard Lyon I / UMR Ecobiologie Microbiologie 5557; J. Gervaix, Université Claude Bernard Lyon I / UMR Ecobiologie Microbiologie 5557; A. Richaume, Université Claude Bernard Lyon I / UMR Ecobiologie Microbiologie 5557

New types of pesticides based on nanoparticles (NPs) are now being used to optimize phytosanitary treatments. However, they can generate soil contamination by metal-oxide NPs such as CuO-NPs which fate and impact on agro-ecosystems is still largely unknown. Several studies showed the deleterious effects of metal nanoparticles (NPs) on soil microbial communities and reported the importance of microbial ecotoxicity (OM) in the fate of these NPs. The main objective of this study was to compare the effect of two conventional varieties (Arrezzo® and Skerzzo®) with two doses of CuO nanoparticles (NPs) on soil microbial communities. Presence of various metals in aqueous streams arising from the discharge of untreated metal containing effluents into water bodies, is one of the most important environmental issue, as human health risks and harmful effect to living organisms occur. In the last decades the amount of Chromium in aquatic and terrestrial ecosystems has increased as a result of different human activities such mining, chemical production and use of wood preservatives. In order to control to evaluate the use of preadapted strains to sublethal concentrations of Chromium, into bioremediation of Chromium containing wastewater. Preliminary results will be shown related to the assessment of the potential of this strategy to increase tolerance of selected species in order to become an interesting tool in the field of bioremediation processes mediated by green algae. Two green algae species were used (C. reinhardtii and C. eugracilis). Both of them differ in its morphological structure and organization level as the former has a cenospheric feature while the second a free unicellular one. Both strains were maintained by a year under sublethal concentrations of chromium ranging from 0.42 to 73 mg/l. These concentrations were chosen base on previous experiments through range finding tests. Sublateral solutions were renewed monthly and algal cells were subcultured in new medium. After the preadaptation period, each sublateral exposed algal population from both strain and one which was never exposed to the metal, considered as the control, were centrifuged. An inoculum of know cell density was prepared with each pellet, and the algae were exposed to a wide range of Chromium concentration solutions. Samples of solution and algal cells were taken for metal determination in order to elucidate the mechanism of resistance origin. The harvested cells were centrifuged and a microwave acid digestion were carried out. Metal determinations in sublateral solutions and in algal sample were made by flame atomic absorption spectrometry. Chromium accumulation and compartmentalization in algal cells would explained the increase resistance observed. Further studies relative to detoxification mechanisms and chelating internal molecules as phytochelatin will be conducted to unravel the tolerance mechanisms involved.

WE173 Use of Posidonia oceanica as a potential bioindicator species of metal pollutants: cellular and molecular responses to mercury exposure
S. Martinez, CONICET PRIET UNLU; W.D. Di Marzio, CONICET-PRIET / PRIET; M. Saenz, PRIET CONICET, National University of Luján; F. Cassani, S. Martinez, s. curieses, J. Alberdi, CONICET PRIET UNLU; W.D. Di Marzio, CONICET-PRIET / PRIET

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and to its capability to accumulate certain environmental metal pollutants, would be a potentially valuable bioindicator species of metal pollutants. Mercury represents one of the most abundant marine pollutants in the Mediterranean Sea. In this study, sublethal effects of this metal were investigated in P. oceanica. Several foliar shoots of this aquatic plant were treated for 4 days (96 h) with different mercury concentrations (0, 0.1 and 1 µg·L⁻¹·Hg Cl₂) under constant laboratory conditions. Biochemical markers of oxidative stress of photosynthetic activity, such as the glutathione S-transferase activities, the ascorbate peroxidase activity, the total antioxidant capacity, the phenols content, the level of lipid peroxidation and the micromolecule frequency were measured in different parts of adult leaves: the blades and the sheaths for antioxidant responses, the meristem and the sheaths for genotoxic effects. Although a limited effect of Hg was measured in analyzed tissues, a significant difference in localization of responses was found in leaves of all treatments.

WE174 Influence of toluene vapor exposure on plant metabolic changes

W. Kim, J. Park, Gwangju Institute of Science and Technology / School of Earth Sciences and Environmental Engineering; S. Kim, Gwangju Institute of Science and Technology / School of Earth Science and Environmental Engineering.

The conventional damage methodology for plants after chemical accident only relied on the change in their phenotype such as leaf-browning, so there had been lots of controversy because of uncertain causality and inaccuracy. The ministry of environment tried to characterize of plant damage by introducing metabolic and genotoxic responses, but they have a poor method for sensitive assessment. However, target metabolite selection process was unclear and the exposure method did not reflect the chemical accident scenario, so the research results have not been put to practical use. Therefore, untargeted metabolomics and vapor exposure chamber were introduced in this study to overcome the limitations of existing research. The development potential of metabolomics-based damage diagnosis tool was tested in P. oceanica, and P. tricornutum, and Hordeum adagger. Toluene was selected as target compound based on the scoring system, which takes into account both accident frequency and hazards. To reflect the realistic chemical accident scenario, plants were exposed in vapor exposure chamber. In this study, the metabolomics responses of plants at early development stages (4th leaf stage) to toluene were evaluated by liquid chromatography quadrupole time-of-flight mass spectrometry (LC-QToF-MS) based untargeted metabolic profiling. The exposed concentration-based and recovery time-based metabolic response patterns were analyzed by Principal component analysis and Partial least squares Discriminant Analysis. Overall, the results of multivariate statistical analysis demonstrated a number of potential biomarkers that were characterized by metabolic approach and provided an insight into quantitative chemical accident damage assessment.

WE175 Influence of soil organic amendments on the phenolic contents in rosemary (Rosmarinus officinalis L.) plants

I. Nogues, National Research Council of Italy / Institute of Agro-Environmental and Forestry Science; M. Portoni, National Research Council / Water Research Institute; P. Gremi, National Research Council of Italy (CNR) / Water Research Institute; M. DE LOS ANGELES BUSTAMANTE MUNOZ, University Miguel Hernández de Elche (Spain) / Department of Agrochemistry and Environment.

Rosemary (Rosmarinus officinalis L., Lamiaceae) is an aromatic shrub native from Mediterranean region and used as a common herb around the world. This species constitutes an exceptional source of different bioactive compounds, mainly phenolic compounds, with proved antimicrobial and antioxidant activity. Furthermore, different studies have shown the potential and important role that this shrub can have in the rehabilitation of degraded soils such as agricultural ones with low levels of organic carbon, contributing to the reduction of erosion and improving soil quality. Within this context, different studies have shown that the metabolism of the phenolic compounds in plants has been associated to environmental factors, such as temperature, rainfall and ultraviolet radiation incidence, as well as soil composition. In this sense, plant nutrient balance in the soil could influence the production of secondary compounds, the concentrations of secondary metabolites in roots, as well as the concentration of available nutrients in the soil. Therefore, this study evaluates the effectiveness of the rosemary plant to improve soil quality and the effect of the incorporation of two composts derived from anaerobic digestates on the phenolic contents of rosemary plants grown a semiarid soil. In the study, two composts (CM, mainly composed by cattle manure anaerobic digestate and CS, mainly composed by pig slurry anaerobic digestate) were applied at a rate of 80 t/ha and 40 t/ha respectively, were incorporated into a semiarid soil from central Italy. These organic amendments were compared with the soil without amendment (control treatment, B) and an inorganic treatment (I). Subsequently, plants of rosemary (Rosmarinus officinalis) were planted on these soils. The efficiency of the treatments was evaluated by analysing chemical characteristics in the soil and the total contents of phenolic compounds and flavonoids in the rosemary plants grown in the different treatments. The results obtained have shown that the incorporation of the organic amendments into the semiarid soil improved soil characteristics, by increasing organic matter and nutrient contents, but also implied a decrease in the concentrations of phenolic compounds in the rosemary plants, probably due to the nitrogen fertilisation increases growth, but also leads to decreased concentrations of carbon-based secondary metabolites, such as phenolic compounds.

WE176 Leaf litter originating from trees treated with systemic fungicides - a new exposure pathway for detoxification systems

K. Newton, University of Montreal; J.P. Zubrod, D. Englert, University of Koblenz-Landau / Institute for Environmental Sciences; S. Lüderwald, Universität Koblenz-Landau / Institute for Environmental Sciences; T.C. Schell, IMDEA Water Institute / Ecotoxicology; P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; M. Konschak, University Koblenz-Landau / Institute for Environmental Sciences; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment.

Leaf litter decomposition, an important process in freshwater ecosystems, is mediated by microbial decomposers and leaf-shredding macroinvertebrates. This process can, however, be modified by chemical stressors such as fungicides. Although fungicide stress has increasingly been assessed in recent years, the systemic nature of some fungicides, which enables the uptake and distribution within treated plants, is not yet considered. Therefore, as a first step, we treated Alnus glutinosa with a mixture of systemic fungicides (SFs; azoxystrobin, cyprodinil, quinoxyfen and tebuconazole) via soil drenching at three levels (control, field application rate (FR), and 10 times the field application rate (FRx10)). During leaf fall, we collected the leaves and assessed the potential impact of the fungicides on microbial decomposers and leaf-shredding macroinvertebrates. We quantified microbial leaf litter decomposition, their community composition and the palatability of leaves after microbial conditioning for the model shredder Gammarus fossarum Koch. By assessing growth and physiological fitness of this species over multiple weeks, we additionally estimated the nutritional quality of leaf litter. Gammaridis preferred conditioned FRx10 over control leaves, which may reflect changes in microbial community structure. This increase in palatability as a consequence of SF may be related to the fungicides’ ability to reduce fungal pest pressure, allowing trees to divert energy and carbon from defense to growth or storage. The same treatment resulted in a 300% increase in gammarid growth, while only a small effect was detected in the variable non-oxidative leaf gut contents. These data suggest that SF may indeed have implications for microbial decomposers and leaf-shredding macroinvertebrates, while the underlying mechanisms are still not fully understood.

WE177 SETAC Plants Interest Group

S. Loutsel, DuPont De Nemour Hellas S.A.

Environmental Risk Assessment in Sediments (P)

WE178 Benthic invertebrate bioturbation activity determines species specific sensitivity to sediment contamination

M. de Baat, University of Amsterdam / IBED-FAME; T.V. van der Meer, University of Amsterdam / IBED-FAME; B. van Hall, University of Amsterdam / IBED-FAME; T.V. van der Meer, University of Amsterdam / IBED-FAME; P. Verdonschot, University of Amsterdam / Department of Freshwater and Marine Ecology; P. Verdonschot, University of Amsterdam / Department of Freshwater and Marine Ecology; M. Kraak, University of Amsterdam / IBED-FAME.

Bioturbation activity of sediment-dwelling organisms promotes the release of contaminants across the benthic-pelagic ecosystem boundary, thereby affecting the exposure to and uptake of sediment associated contaminants at the sediment-water interface by themselves and the entire community around them. This way, bioturbation activity may contribute to species specific sensitivities to sediment associated compounds. Therefore we assessed if invertebrate bioturbation activity determines species specific sensitivities to sediment contamination. For two metals, Ni and Cu, sufficient data were available to construct Species Sensitivity Distributions (SSD). The position of the species in the SSDs could indeed be linked to their bioturbation rate: the most active bioturbators being the most sensitive benthic invertebrates. Active bioturbators thus enhance their exposure and therewith their sensitivity to sediment associated toxicants. Moreover, active bioturbators can hence promote the release of sediment-associated contaminants across the benthic-pelagic ecosystem boundary, thereby stimulating delivery of contaminants from what is often the most polluted environmental compartment to freshwater ecosystems. It is concluded that trait based ecotoxicology offers a possibly potent tool for predicting sensitivity of benthic invertebrates and the benthic community to sediment-associated contaminants.

WE179 Effect based sediment quality assessment incorporating chemical fingerprinting

N. Weering, University of Amsterdam/IBED Institute / FAME; M. de Baat, University of Amsterdam / IBED-FAME; B. van Hall, F. Selhorst, University of Amsterdam / Department of Freshwater and Marine Ecology; S. Droge, University of Amsterdam/IBED Institute / IBED; M. Kraak, University of Amsterdam / IBED-FAME; P. Verdonschot, University of Amsterdam / Department of
Sediment quality assessment is often based on chemical analysis only, occasionally including toxicological assays. Full sediment quality assessment, including chemical and macrofauna analysis and toxicological assays, is not the standard procedure due to high costs. Based on chemical analysis only, it is not always clear whether sediment management in form of dredging and landfill or remediation is necessary. To reduce costs of sediment management on the one hand and to increase environmental benefits on the other, the right priorities need to be set. To do so, universities of Lorraine / Laboratoire Interdisciplinaire des Ecosystems et des Milieux Aquatiques and macrofauna analyses. Chemical, toxicological and ecological data is available from freshwater/sediment monitoring campaigns in the Netherlands. A multivariate analysis was performed to identify contaminants with high impacts on the bioassays. From the 49 chemicals included in the dataset, 28 were significantly related to the outcome of Daphnia magna and Chironomus riparius. The Species Sensitivity Distribution (SSDs) method was used to quantify the ecological risk associated with concentrations of contaminants. Based on the SSDs the potentially affected fraction (PAF) of species was calculated. These PAFs were used to calculate the multiple substances PAF, combining effects posed by multiple compounds. Such correlation analysis have not been conducted previously for a large dataset of field-collected sediments in the Netherlands. With our work we contribute to the quantification of relationships between chemical concentrations and toxicological assay in sediments. These relationships can be used in future analyses of predictive abilities of sediment quality and can be applied in an assessment tool for sediment management to determine management strategies.

WE182 Integrative approach to assess ecological risks of sediment metallic contamination in Lake Ohrid (Albania)
L. Martinez, LIEC (CNRS UMR 7360, Université de Lorraine) / Laboratoire Interdisciplinaire des Environments Continentaux, CNRS UMR 7360; E.M. Giamberini, Université de Lorraine / LIEC, CNRS; D.A. Vignati, CNRS / LIEC UMR7360; S. Pain-Devin, Université de Lorraine - UL / LIEC - CNRS - UMR 7360; S. Devin, LIEC, CNRS UMR 7360, Université de Lorraine / LIEC, CNRS; F. Guérol, Université de Lorraine - UL / Laboratoire interdisciplinaire des environnements continentaux LIEC CNRS UMR 7360; L. Giamberini, Université de Lorraine CNRS UMR 7360 / LIEC, CNRS.

It is now widely admitted that chemical monitoring of pollutants in waters and sediments is not sufficient to assess the risks caused by such pollution in aquatic ecosystems, since chemical data alone provide no indication of biological effects. Biological responses of exposed organisms need to be taken into account, allowing to define the ecotoxicological status of the studied system. The ancient lake Ohrid, the oldest and most biodiverse lake in the Balkans, was chosen as case study. The Albanian side, due to the presence of ultramafic rocks, was a large mining area exploited to produce nickel, chromium, and iron until the early nineties. Several ore dumps from this past activity still remain near the shoreline, representing one potential input source of these metals. Several creeks flowing across soils naturally rich in metals also contribute to metal inputs into the lake. We studied three sites along the Albanian shoreline of Lake Ohrid, and defined by different metal pressures: “Pog” in an urbanized area but considered as dimly contaminated by metals, “Mem” and “Pjö” located in the ultramafic area of the lake, at the vicinity of a Fe-Ni dump site for “Mem”, or nearby the outlet of a creek for “Pjö”. In the two sites under metallic pressure, sediments contained high levels of metals with concentrations reaching 93.8 mg/kg for Co, 345.1 mg/kg for Cu, 10.9 mg/kg for Ni and 872.9 mg/kg for Mn. Despite these high concentrations, metals are not necessarily bioavailable. This is why it is also important to combine chemical characterization (total and available pools) with the study of lethal and sublethal effects after acute and chronic exposure. In our study, we assessed ecological risks in Lake Ohrid using an integrative approach consisting in: (1) chemical and physical characterizations of sediments, (2) assessment of metal bioavailability, (3) ecotoxicological bioassays, and (4) the study of sub-lethal effects on organisms. During this presentation, the main results from this integrative work at Lake Ohrid will be presented.

WE183 Active Biomonitoring and DGT Passive Sampling: Holistic Assessment of metal bioavailability in sediments and associated risks
K. De Schampaert, Universiteit Antwerpen / Department of Biology (SPHERE and ECOBE Research Groups); H. Hetjens, University of Antwerp / Department of Biology (SPHERE Research Group); J. Touchais, E. Amato, L. Bervots, University of Antwerp / Department of Biology (SPHERE Research Group); P. Meire, University of Antwerp / Department of Biology (SPHERE Research Group); R. Blust, University of Antwerp / Department of Biology (SPHERE Research Group)

Impacts of sediment metal contamination on aquatic ecosystems and their functioning remain a widespread problem. The ecotoxicological risk associated with metal contamination is dependent on metal speciation, sediment characteristics and the behavior and physiology of the affected organisms. Hence, bioavailable concentrations, rather than total metal concentrations, are often the critical factor in sediment risk assessment. Determination of bioaccumulation in organisms is a frequently used indicator for bioavailability. However, active and passive biomonitoring techniques are often time consuming and highly dependent
on the exposed organisms, limiting comparability and standardization. Diffusive gradient in thin films (DGT) passive sampling is an innovative technique, allowing for the time-integrated measurement of potentially bioavailable metals in sediments or surface water. Divalent metals are selectively accumulated on a Chelex-embedded hydrogel layer, providing a measurement of labile and weakly-bound metals. To evaluate DGT passive sampling measurements as a potential indicator of biocaccumulation in organisms, a field experiment will be carried out in April 2018 on 6 locations in Flintham (Bromsgrove), a freshwater and 3 brackish aquatic systems. Bioavailability of metals will be assessed by active biomonitoring through a 4 weeks exposure of caged microvertebrates, after which bioaccumulation will be determined. The organisms will be exposed both at the sediment water interface and in the water column. During a pilot study, carried out in November 2017, 3 bivalves and a polychaete worm are exposed in the Zenne river (north of Brussels) to test for their active biomonitoring applicability. During the 4 weeks exposure period, DGT passive samplers will be deployed 3 times for a period of 24h at the sediment water interface and in the water column. Relationships will be determined between the bioaccumulation in the exposed organisms and the determined DGT fluxes. Bioaccumulation in an active sampling approach and passive sampling measurements as the sediment water interface and in the water column will be evaluated. The experiment aims at establishing relationships between bioaccumulation in different microvertebrate species and passive sampling measurements, and further validating the DGT passive sampling technique as a monitoring tool for sediment quality assessments in both freshwater and brackish aquatic systems.

WE184

Bioturbation in contaminated sediments: effects on exposure, toxicity and biogeochemistry. T.M. Remaillié, W. Bennett, Griffith University / Environmental Futures Research Institute; S.L. Simpson, D.T. Welsh, Griffith University / Environmental Futures Research Institute; E.D. Amato, University of Antwerp / Department of Biology; D.T. Welsh, Griffith University / Environmental Futures Research Institute; E. Lambi, University of South Australia / Future Industries Institute; D. Howard, Australian Synchrotron; D.F. Jolley, University of Wollongong / School of Chemistry.

Sediments are a major sink for a range of contaminants. Organism-sediment interactions such as bioturbation can alter sediment physicochemistry, and facilitate the diffusion of reactive chemical species (e.g. O2) into deeper sediments, potentially changing the oxidation state of various redox-sensitive materials and the fate and toxicity of contaminants. We applied multidisciplinary to: (i) characterise influences of bioturbation on contaminant fate, exposure and toxicity to aid current sediment quality guidelines; and (ii) assess the potential use of diffusive gradients in thin films (DGT) to monitor bioturbation in the management and natural recovery of heavily degraded sediment ecosystems. Increased bioturbation in predominantly metal-contaminated sediments increased bivalve (Tellina deltoidalis) and amphipod (Victoriopsia australiensis) survival from 53% to 100% and 42% to 93%, respectively; and reproduction in a second amphipod (Melita plumulosa) from 3% to 65%. This was attributed to the decreased concentrations of dissolved copper in the overlying water associated with bioturbation. Conversely, increased bioturbation in sediments contaminated by metals and hydrocarbons decreased reproduction (44 to 23%), which was attributed to an increased release of polycyclic aromatic hydrocarbons (PAHs). High-resolution chemical imaging dissolved oxygen and metals in a legacy contaminated sediment mesocosm with a bioturbator present showed the induction of bioturbation. Waterway waters were also shown to facilitate organism-induced fluxes of nickel and zinc into burrow and overlying waters. The presence of nickel and zinc in burrow and overlying waters demonstrated that organism exposure is likely to be greater from the burrow waters than from the pore waters. This is consistent with increased accumulation of zinc observed with co-habitation of bivalves and amphipods. Low copper and lead concentrations in burrow waters during bioturbation events was consistent with the results of previous tests, where copper concentrations were lower in the presence of high bioturbation intensities, possibly due to binding with iron-(oxy)hydroxide phases or to resuspended particulate phases. These results highlight the importance of considering organism-interactions during sediment quality assessments, and the contributions they have to biogeochemistry and contaminant exposure to surrounding ecosystems.

WE185

The diffusive gradients in thin films (DGT) technique predicts toxicity of nickel contaminated sediments to a marine amphipod M. Gillimore, R. Water (Environment Agency); G.A. Price, University of Wollongong / School of Chemistry; L.A. Golding, CSIRO Land and Water; J. Stauber, CSIRO / CSIRO Land and Water; M.S. Adams, CSIRO; S.L. Simpson, CSIRO Land and Water / Centre for Environmental Contaminants Research; D.F. Jolley, University of Wollongong / School of Chemistry.

Mining of lateritic nickel ore deposits within the Southeast Asia and Melanesia region is expected to intensify as sulphide nickel ore deposits become depleted. The close proximity of these mining operations to coastal ecosystems places marine benthic organisms at a potential risk of adverse effects related to nickel exposure. Currently, limited data exists for the effects of sediment nickel exposure on coastal marine organisms. The diffusive gradients in thin films (DGT) technique has emerged as a tool that allows for the rapid in situ measurement of the lability and dynamics of metals in sediment. The objective of this research was to determine effects thresholds for sediment-nickel by measuring reproduction of the estuarine-marine amphipod, Melita plumulosa in 10-d whole-sediment bioassays with three nickel-spiked sediments and two field-collected nickel-contaminated sediments with varying chemical and physical properties. We compared a concentration-response (C-R) relationship obtained using traditional method of extraction of metals from sediments with DGT-labile nickel to determine whether DGT can be used to predict nickel bioavailability and toxicity. Effect concentrations of total recoverable nickel (TR-Ni) to cause a 50% impairment in reproduction (EC50) were 2000 (1200-2900), 1100 (580-1700) and 1100 (740-1500) mg/kg for the silty, sandy-silt and sandy sediments, respectively. Concentration-response relationships based on DGT-labile Ni fluxes had less variation and better-predicted toxicity in the field collected nickel-contaminated sediments. Site 1 (2000 mg/kg TR-Ni) and Site 2 (1300 mg/kg TR-Ni) had reproducitve responses of 88% (±10) and 71% (±11) of the control, respectively. The EC50s based on DGT-labile Ni were 2.3 (1.7-3.4), 3.3 (1.7-4.9) and 2.0 (1.3-3.0) mg/kg for the silty, sandy-silt and sandy sediments, respectively. Concentration-response relationships based on DGT-labile Ni fluxes had less variation and better-predicted toxicity in the field collected nickel-contaminated sediments. Site 1 (0.4 mg/m² DGT-labile Ni) and Site 2 (1.0 mg/m² DGT-labile Ni) sediments, respectively reproduce responses were 88% (±10) and 71% (±11) of the control. This demonstrates that amphipods were responding to the labile nickel as measured by DGT and further supports its use in nickel risk assessments.

WE186

Identifying key toxicants in sediment samples from urban waterways in Guangzhou, China using an integrated method of TIE and EDA. J. Yeung, H. Li, F. Cheng, Jinan University / School of Environmental Engineering; L. de Vos, M. Alencastro, École Polytechnique Fédérale de Lausanne / Central Environmental Lab; S. Höss, Ecossa / Animal Ecology; J.J. Martinez, E. de Villeneuve, Villeurbanne / Microbial ecology of anthropised river systems; L. De Alencastro, Ecole Polytechnique Fédérale de Lausanne / Central Environmental Laboratory; N. Dubois, Eawag; L. Rossi, Hydrique Ingénieurs; S. Höss, Ecosa / Animal Ecology; B.J. Ferrari, Centre Ecotox EAWAGPEF.

Sediments from an urban waterway represents an important compartment in surface waters. It constitutes a habitat or spawning site for many organisms and is an essential trophic resource for the time dynamics of metals in sediment. The objective of this research was to determine sediment mortality to toxicants in urban waterways. For this purpose three urban waterways were selected in Guangzhou, China, as potential contaminants of urban waterways. Whole-sediment TIE in combination with bioavailability-based extraction found that sediment mortality to the benthic invertebrate, Chironomus dilatus was caused by organics and metals jointly and organic pollutants contributed to the mortality for all samples. To better elucidate the roles of non-target organic contaminants in sediment toxicity in these sediments, EDA tests were performed. Bioaccessible contaminants in sediment samples were extracted by XAD resin. Cell viability of the extracts was assayed using the cell counting kit-8 assays. To take tissue specificity into consideration, four cell lines (HepG2, MCF-7, A549 and SH-SY5Y) were used to distinguish toxicants related to metabolism dysfunction, endocrine disruption, respiratory toxicity and neurotoxicity, respectively. All test sediment samples showed significant cell proliferation of SH-SY5Y cell line, but little effect on HepG2 and A549 cell lines. The results were further confirmed by toxicity testing using C. dilatus. One sediment sample impacted MCF-7 cell line. The proliferation of SH-SYSY proliferation was partially explained by oxidative stress. The SH-SYSY cell line was used for further EDA experiments after separating the extracts into 35 fractions using GPC and NPLC. In conclusion, an integrated method of TIE and EDA would provide an environmentally relevant and toxicant specific approach to effectively determine causality of sediment toxicity by combining the merits of the two methods.

WE187

Water discharges from the city of Lausanne during rainfall in Lake Geneva: Use of a triad approach to assess their influence on lake water quality. M. Carrasco-Martinez, T. Benjemai, R. Vivien, Centre Ecotoc; S. Pesce, Ireata Lyon-Villeurbanne / Microbial ecology of anthropised river systems; L. De Alencastro, Ecole Polytechnique Fédérale de Lausanne / Central Environmental Laboratory; N. Dubois, Eawag; L. Rossi, Hydrique Ingénieurs; S. Höss, Ecosa / Animal Ecology; B.J. Ferrari, Centre Ecotox EAWAGPEF.

Water macroinvertebrates, after which bioaccumulation was determined. The organisms will be exposed both at the sediment water interface and in the water column. Relationships will be determined between the bioaccumulation in the exposed organisms and the determined DGT fluxes. Biocaccumulation in an active sampling approach and passive sampling measurements as the sediment water interface and in the water column will be evaluated. The experiment aims at establishing relationships between bioaccumulation in different microvertebrate species and passive sampling measurements, and further validating the DGT passive sampling technique as a monitoring tool for sediment quality assessments in both freshwater and brackish aquatic systems.
To do this, a sampling grid composed of 15 sites was developed in the discharge area of the effluent from the Flon river into the lake. At each point, sediment samples were collected to measure metal concentrations and assess the ecotoxicological quality of sediments in the laboratory using a whole sediment toxicity test with ostracods. At six selected sites in the central transect of this sampling grid, corresponding to the extension of the outlet of the Flon river, a more detailed monitoring program was applied, with measurements of PCBs and PAHs concentrations, as well as for the chemical toxicity tests with chironomids, macrophytes and nematodes, as well as the study of the structure of oligochaete communities and tolerance of microbial communities induced by pollution (PICO T) were carried out on. The results obtained showed that contamination induced by urban stormwater discharges, identified mainly as copper, zinc, PCBs and PAHs contamination, was eliminated in the period under study. After the exposure, short-term toxicity tests did not indicate significant toxicity in this area, the study of in situ communities revealed the presence of pollution-resistant species among oligochaetes and bacteria. For the most remote sites, the effects observed in the sediments do not appear to be directly related to the stormwater discharges. The origin and dynamics of the contamination still require further investigations, based in particular on a hydrodynamic model. Overall, this study paved the way for the development of practical tools for assessing the impacts of urban stormwater discharges in lakes in Switzerland.

WE188

Ecotoxicological profiling of sediments along the River Wurm by Aachen (North-Rhine-Westphalia, Germany)

A. Shulakeivich, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research; Y. Müller, RWTH Aachen University / Institute for Environmental Research; S. Holz, RWTH Aachen University / Department of Ecosystem Analysis ESA; S. Schiwy, RWTH Aachen University / Department of Ecosystem Analysis; S. Karnatz, RWTH Aachen University / Institute for Environmental Research Department of Environmental Analysis; O. Sester, H. Hollett, RWTH Aachen University / Institute for Environmental Research

River sediments serve as a sink and source for micropollutants. Characterized by their semi-dynamic behaviour, sediments can assimilate contaminants. Naturally occurring events such as storms, currents and flood events, as well as human activities like dredging can cause resuspension of sediments and, thus, pose a threat to aquatic organisms. So far, many investigations have been conducted to assess the biological responses in the water phase of streams being impacted by effluent from waste water treatment plants (WWTPs). However, the impact of WWTPs to sediments is still unknown. The present study was taking place within the Demo2 AC Project aimed to assess the ecotoxicological status of the River Wurm near Aachen. This stream is heavily impacted by anthropogenic activities, such as urbanisation, agriculture, industry, etc. Moreover, the River Wurm receives effluents from various WWTPs within the catchment area. Two of them, the WWTP Aachen Soers and the WWTP Eilendorf, served as investigative objects. Special attention is paid to the WWTP Aachen Soers, which will be upgraded by a full-scale ozonation at the end of 2017. To evaluate a possible impact of the WWTPs on the current ecotoxicological status of the stream a comprehensive ecotoxicological profiling of the sediments from 7 sites up- and downstream of the aforementioned WWTPs was performed. The samples were tested both as native and freeze-dried samples in the sediment contact assay with Danio rerio. Sediment extracts (25 g SEQ/ml) were applied for the fish embryo toxicity test with Danio rerio. Test results indicate the need for deeper investigation of the disruptive and mutagenic potential. The results showed estrogenic and mutagenic potential in sediment extracts upstream the tested WWTPs. The embryotoxic potential (enlarged heart, insufficient blood circulation, oedema, etc.) was accounted for the sediment extracts upstream of the WWTP Aachen Soers only. Exposure to native sediments did not lead to any adverse effects in embryos of the zebrafish. However, exposure to freeze dried sediments revealed reduced reactivity of fish embryos. Observed neurological conspicuousness will be verified by further investigations. The described toxicological profiling of sediments will also be completed by chemical analysis. Phase 2 of the Demo2 AC Project will contain comparative studies in order to evaluate the possible influence to sediment toxicity after implementation of full-scale ozonation.

WE189

Comparing conventional and integrative concepts for sediment classification systems

S. Faris, Hamburg University of Applied Sciences (HAW); S. Höff, Ecosys / Analytical Ecology; S. Heise, Hamburg University of Applied Sciences / Life Sciences

Environmental regulations and guidelines in Europe for assessing the quality of aquatic sediments and dredged material predominantly demand chemical data, and decision making mostly does not integrate the information from different lines of evidence (1, 2). Ecotoxicological data requirements are often limited, with the final classification of the sample not preserving the information of all applied biotests (3). Improved, holistic characterization of sediments and dredged material is needed, to enable a better risk assessment that conserves the ecological quality, is practical and economically feasible at the same time. This poster will present the concept of a study in the scope of the Interreg project “Sullied Sediments” (http://northsearegion.eu/sullied-sediments/) and will discuss first results. The study aims at comparing and evaluating conventional and alternative, integrative and science-based sediment classification concepts for holistic assessments of sediment quality, such as fuzzy-logic based classification (4, 5). Selected concepts will be applied on the classification of sediments from inland waterways in the North Sea region. A sediment quality triad approach will assess the ecotoxicity, the ecological condition and the chemical quality of sediment samples from the catchment area of the North Sea region with management problems related to polluted sediments. The locations of the sites are in the Port of Hamburg and along the River Elbe in Germany, on the Rivers Hull in the UK and Scheldt in Belgium and in the Netherlands. The applied biotest battery for assessing the ecotoxicological potential of the sediments will cover different trophic levels, different sensitivities and different exposure pathways, considering the toxicity of sediment contact tests, eluates and extracts. The analysis of the benthic meiofaunal community will assess the ecology of the sediments. The chemical analyses will comprise a broad range of historic contaminants and emerging pollutants, originating from industrial activities, agriculture and pharmaceuticals. This work will be the basis for developing an improved, integrated sediment classification system. References: Ahlf et al., 2002. JSS 2: 37–42 Deckere et al., 2011. JSS 11: 504–517 Duff et al., 2003. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) Hollert et al., 2002. Ecotoxicology 11: 311-321 Keitler et al., 2009. JSS 9: 168

WE190

Submarine sewage outfall adversely affects the sediment quality of Santos, Brazil estuary - An acute toxicity study

A. dos Santos, Faculdade de Ciências Farmacêuticas - USP / Departamento de Análises Clínicas e Ecológicas; M. Artal, University of Sao Paulo - USP / Toxicology and Toxicology analysis; R. de Souza, UNIP / Toxicology and Toxicology Laboratory; N. Palhares, UFRJ / Toxicology and Toxicology Laboratory; R. Azevedo, University of Sao Paulo - USP / Toxicology and Toxicology Laboratory; J.A. Vendemii, F.I. Vecchi, University of Campinas / LEAL, Laboratory of Ecotoxicology and Biological Safety (BMU) Hollert et al., 2002. Ecotoxicology 11: 311-321 Keitler et al., 2009. JSS 9: 168

WE191

Swimming in turbid water: impacts of suspended fine sediments on fish physiology

M. Lefèvre, S. Amadruitt, L. Merle, J. ORourke, Hepia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; L. Espinat, INRA; S. Bony, INRA-CNRS / IPE; A. Davaux, INRA-CNRS / UMFR LEHNA / INRA IGH ENTEX / G. Guillard, INRA, Université Savoie Mont Blanc / CARTEL Centre alpins sur les réseaux trophiques des écosystèmes limniques; F. Cattaneo, R. Santos, Hepia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group

Anthropogenic activities lead to increasing sediment deposition in many rivers worldwide which must be managed to preserve industrial activities and population safety. In the context of the sediment dredging and dam sediment flushing are common actions that release downstream accumulated sediments thus increasing sediment loads which in turn impairs freshwater biodiversity. Reported impacts on fish species vary from mortality, behavioral changes, to physiological and histological impairment depending on SSC and exposure duration. Juveniles of rainbow trout (Oncorhynchus mykiss) and roach (Rutilus rutilus) were exposed in semi-static conditions for 40-200 and 1000 mg/L of non-contaminated fine sediments (mica) for 28 days, mimicking dredging operations in terms of duration and environmental concentrations. They were sampled weekly, and mortality, condition index and histological gill lesions were evaluated. Several physiological parameters were also investigated to assess the level of oxidative stress and genotoxicity. Oxidative damages in gills were investigated measuring the level of lipid peroxidation (TBARS) as well as superoxide dismutase activity (SOD) involved in oxygen radical metabolism. The level of primary DNA damage in erythrocytes was measured with the alkaline comet assay. This preliminary work highlight that 28 days of exposure to fine sediments at high concentrations do not induce drastic
mortalities as predicted by models and the scientific literature. Physiological parameters investigated in rainbow trout acted as early signals of biological defects pointing out a high level of genotoxicity measured in eurypterids in exposed individuals as well as in the control batch; these decreased during the experiment until a basal level pointing out the resilience of fish whereas they were exposed for 28 days to high fine sediment concentrations. Roach exposure to suspended fine sediments did not induce genotoxicity or an oxidative stress response. These results meant that fine sediment exposure did not lead to a physiological stress through the alteration of respiration and osmoregulation homeostasis but suggested that trout experienced undesired past stressful conditions (aquaculture) independent from the sediment exposure. However, we cannot conclude that exposures of juvenile fish to such sediment concentrations would not lead to biological detrimental effects without further considering environmental sediment quality.

**WE192 Assessing the bioavailability of metals in natural sediments by DGT passive sampling and bioaccumulation**

H. Hetzö, SPHERE / SPHERE, K. De Schamphelaere, University of Antwerp / Department of Biology SPHERE and ECOERE Research Groups; J. Touchais, E. Amato, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)

Worldwide, high metal concentrations from recent and historic sediment contamination form a widespread problem and are of major concern for water system management due to their impact on the surrounding water quality and resident flora. Sediment (bio)availability metrics can be present in results of this study in physicochemical forms, some of which may be unavailable, non-toxic and therefore not-harmful to organisms so that the interplay between chemical speciation and biological effects can be very site specific and hard to predict. Total sediment concentrations are therefore often found to be poor predictors of the actual risk and a measure of bioavailability should be considered in risk assessment procedures. In this regard however, the potential of the method of the bioaccumulation in exposed organisms has been experienced to be highly disruptive, time consuming and limited in comparability as its results are strongly dependent on the analysed organisms themselves. Therefore, an increasing need for less disruptive, more reliable and standardized methods exists. Recently, passive samplers have been tested to estimate bioavailable contaminant fractions as well as the contaminant flux over sediment-water interface. Diffusive Gradient in Thin film samplers (DGTs) have been indicated to provide reliable predictions of metal bioavailability and toxic potential for single (benthic) invertebrate species under (semi-) controlled conditions. The main objective of this study is to further evaluate the use of DGT passive samplers as indicators for the bioavailability of metals for (benthic) aquatic macroinvertebrates and to test the robustness of the results from laboratory studies under field conditions. In an extensive field and laboratory study, which will be performed in April 2018, the impact of a range of contaminated natural freshwater sediments with known physicochemical characteristics and metal gradients on species performance will be tested. Bioavailable metal fractions will be determined by the use of DGTs and by measuring the metal body burden and metal exposure of the different tested taxa. The results of this study are expected to increase the insights in the applicability of passive samplers for future sediment risk assessment and to be useful for the development of more standardized and integrated approaches.

**WE193 Ecotoxicological effects of sediments influenced by a municipal wastewater treatment plant - state of a receiving river before implementing an ozonation treatment**

N. Willbrand, RWTH Aachen University; A. Shiliakevich, Institute for Environmental Research (RWTH - Aachen University) / Institute for Environmental Research; Y. Müller, RWTH Aachen University / Institute for Environmental Research; S. Schiwy, RWTH Aachen University / Department of Ecosystem Analysis; H. Hollert, RWTH Aachen University / Institute for Environmental Research

Since our economic progress continues, the environmental pollution increases. The contamination of the aquatic environment with chemicals is one of the major concerns of our time and to still the pollution, different approaches have been applied in industrial processes and consumables every year. A considerable part of it enters waterbodies from diffuse and point sources. [1] Micropollutants originating from e.g. pharmaceuticals and personal care products may cause adverse effects on different biological and ecological levels. A major concern is the fact that these substances are not fully removed during common wastewater treatment and, therefore, can be discharged into surface waters. To diminish the discharge of micropollutants from wastewater treatment plants (WWTP) additional treatment steps are required. Ozonation has been shown to be an effective method with reasonable costs. Hence, ozone treatment of the entire effluent is implemented in the Aachen-Soers WWTP, Germany, within the Demo-OAC-project. In this context, the actual ecotoxicological state of the recipient water, the River Wurm, and the upstream tributary, the River Haarbach, was evaluated before the implementation of the facility. The River Haarbach receives effluents from the Aachen-Elendtrop WWTP. Therefore, water and sediment samples from various sites upstream and downstream the WWTPs were investigated. This study focuses on the assessment of the sediment samples of the both rivers, since they play an important role in e.g. binding and remobilisation of substances. After the extraction of the sediments via pressurised liquid extraction, cell-based biosassays with reporter cell lines will be conducted to estimate the anti-estrogenic and oxidative stress potential. Following, both native samples and extracts will be tested in the behavioural light/dark transition test with Daphnia pulex. This test utilizes the fish’s scototaxis (aversion to bright areas and natural preference for the dark) to evaluated effects of neurotoxic compounds within these matrices. [1] Schwarzenbach et al. (2006).

**Science.**

**WE194 Dredging sediment quality evaluation: a comparison of an ecotoxicological classification using an weight-of-evidence approach and a “pass to fail” criteria**

V. Piazza, E. Costa, F. Garaventa, CNR ISMAR; D. Sartori, V. Vitiello, D. Pellegrini, ISIPRA Institute for Environmental Protection and Research; I. Lanzoni, Department of Life and Environmental Sciences Polytechnic University of Marche Ancona Italy; F. Regoli, Università Politecnica delle Marche; M. Faimali, CNR ISMAR

Recently a new regulation for the management of dredging sediment has been introduced in Italian legislation (Decree of Italian Ministry of Environment n. 173/2016), establishing criteria and methodological procedures for dredging sediment characterization, their classification and identification of appropriate management options and monitoring. One of main novelties is represented by the Envirol at al. tox model was assumed by ecotoxicology, M. Boereen characterization. A battery of biosassays that considers the use of three species belonging to different trophic levels has to be applied both to solid phase and liquid phase (sorption or elutriate) of sediment. The results of ecotoxicological analyses are then assessed as a whole at the level of “battery” (not of single bioassay), weighting the biological relevance of the measured effects, the sensitivity of organism, the statistical significance of measured results and the impact of chemicals in the sediment on the chemical composition of the water. Chemical and ecotoxicological data are finally integrated for sediment quality assessment, following the weight of evidence (WOE) criteria, this representing an innovative approach respect to previous regulation, where chemical classification was determined by at least one parameter exceeding the threshold level and ecotoxicological classification was determined by the worst bioassay result of the whole battery. In this work, a comparison between “old” and “new” sediment quality assessment was performed, applying the two classification methods to ecotoxicological data obtained on dredging sediments from different study sites. Results obtained underline the importance of using an integrated and weighted approach (WOE) respect to a “pass to fail” criteria.

**WE195 Toxicity of sediment-bound lufenuron to aquatic arthropods in laboratory biosassays**

T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; D. Belgers, Wageningen Environmental Research Alterra / Environmental Risk Assessment; H. Hetjens, RWTH Aachen University / Institute for Environmental Research / Environmental Risk Assessment Team; M. Kraak, University of Amsterdam / IBED-FAME; J. Vonk, University of Amsterdam IBED Institute / Aquatic Environmental Ecology; I. Roessink, Alterra / Environmental Risk Assessment

Lipophilic pesticides are frequently detected in sediments, potentially leading to toxic impacts on benthic organisms. Currently, prospective sediment risk assessments for pesticides are mainly based on results of laboratory biosassays with a few standard test species (Chironomus sp. and Hyalella azteca). It is, however, uncertain whether these standard benthic test species are representative for a wider array of freshwater benthic organisms. We selected the benzoylurea insecticide lufenuron as one of the benchmark substances to evaluate the prospective environmental effect assessment procedure for sediment-associated pesticides. 10-day and 28-day toxicity estimates from sediment-spiked laboratory biosassays with benthic arthropods belonging to different taxonomic groups are presented. In the 10-day sediment-spiked toxicity tests the LC50 values showed the following order from low to high LC50: Caenis horaria > Chironomus riparius > Gammarus pulex > Chironomus dilutus > Hyallella azteca > Asellus aquaticus and Sialis lutaria. The Hazardous Concentration 5% to the tested species (HCS) and 95% confidence limit) derived from these 10-d LC50 values was 2.2 (1.5-5.7) µg/g organic carbon (OC). This HCS value is approximately a factor of 2 lower than the 10-d LC50 estimate (4.37 µg/g OC) for the most sensitive standard test species Chironomus riparius. Valid 28-d LC10 values could be derived for 7 benthic arthropods. These 28-d LC10 values showed the following order from low to high LC10: Asellus aquaticus > Chironomus riparius > Caenis horaria > Ephemera danica > Hyalella azteca > Gammarus pulex > Sialis lutaria. The HCS and 95 confidence interval derived from these 28-d LC10 values was 0.13 (0.02-1.50) µg/g OC. This HCS value is approximately a factor of 3 lower that the 28-d LC10 estimate for the most sensitive standard test species Chironomus riparius (0.49 µg/g OC). These data show that Chironomus riparius is a representative standard test species to assess the potential risks of sediment exposure to the insecticide lufenuron. The HCS obtained from 28-LC10 values was a factor of 6 lower than the the NOEC for the most sensitive
population (0.79 µg/g OC) in a sediment-spiked microcosm experiment, while the HC5 from 10d-LC50’s was approximately a factor of 3 higher than this microcosm threshold concentration.

WE196 Application of an undisturbed sampling technique for depth related analysis of marine water layers to 15 µg/g TC219 sediment test systems A. Dorn, Hochschule Niederrhein / Department of Chemistry; P. Dalkmann, Bayer AG Crop Science Division; D. Faber, Bayer AG, Crop Science Division / BCDS ETX Ecotoxicology; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; E. Hellpointner, Bayer AG, Research & Development, Crop Science / Environmental Safety; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; M. Jäger, Hochschule Niederrhein / Department of Chemistry Sediment toxicity testing of plant protection products (PPP) is gaining an increasing awareness within the scientific and regulatory community. Currently, PPP concentrations in sediment and pore-water of Chironomid toxicity tests acc. to OECD test guideline (TG) 218/219 are determined as mean over the entire sediment layer of the test system. Hence, a depth-related measurement would contribute to a more accurate assessment of the effective exposure for the predominantly surface sediment dwelling test organism. Therefore, we developed an undisturbed sampling technique and processing enabling the depth-related analysis of active substances in pore-water and adsorbed to sediment particles. After removing the water phase, plastic tubes were stung into the ca. 15 mm-thick sediment layer, which was subsequently frozen by liquid nitrogen. By the use of a special developed cutting device, the sediment cores were cut into three slices providing a thickness of ca. 5 mm. Each sediment slice was centrifuged to isolate the pore-water. A sequential extraction was performed to extract the sediment adsorbed residues. After combining the sediment extracts, porewaters and sediment extracts were analysed by LC-MS/MS. To validate this newly developed sampling technique, a Chironomid toxicity study acc. to OECD TG 219 was conducted. Two model compounds (logPow < 1) and B (logPow > 3) were applied as mixture at nominal concentrations of 2 µg/L. To investigate the spatiotemporal behaviour of the compounds, test systems were incubated and processed 3, 7, 14, 21, and 28 days after treatment (DAT). The concentration of the applied compounds decreased in the overlying water during the experimental duration. Both compounds were primarily found adsorbed on the sediment phase (ca. 40-50 % of applied compounds). Approx. 0.2 - 1 % of the applied compounds were recovered in the pore-water at the same time. The analytical results of pore-water and sediment extracts show that the highest amounts of both compounds were in the upper layer of the sediment during the experimental duration. Nevertheless, the results indicate the concentrations differences between the top layer and the layers below will be equalized in the course of time. These first results indicate that the newly developed sampling technique can provide a substantial contribution to a more realistic determination of exposure concentrations in chronic water-sediment toxicity tests, leading to an improved sediment risk assessment.

WE197 SETAC Sediment Interest Group
P.K. Sibley, University of Guelph / School of Environmental Sciences

Improving the environmental risk assessment of the aquaculture 'Blue Revolution' (P)

WE198 Global overview of aquaculture production with a focus on the development and current status of the activity in Portugal C.V. Rocha, MARE-FCUL; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University/Biology Department & CESAM, Aveiro University Aquaculture activity experienced true global development firstly at the beginning of the 1900’s and then around 1970’s, as a result of the awareness of the negative impacts that years of intensive fisheries brought to wild stocks’ status, which contributed to acceptance of the effective exposure for the predominantly surface sediment dwelling test organism. The Gilthead seabream and the gilthead seabream specimens reared in semi-intensive systems in two southern European estuarine systems, the Sado and Mondego estuaries in Portugal. Quantification of total protein, carbohydrate and fatty acid profiles were determined to assess differences between the organoleptic composition of organisms of the same species reared in four different aquacultures (two estuaries in each estuary). No significant differences were found among groups of both species regarding protein content. A significant influence of the rearing site was found for the European seabass regarding saturated (SFA), monounsaturated (MUFA) and highly unsaturated fatty acid (HUFAs) contents, either between estuaries and within each estuary. In the Gilthead seabream, SFA, MUFA, polynsaturated fatty acid and HUFAs contents were also influenced by the rearing site. Eicosapentaenoic acid, docosahexaenoic acid, achidonic acid and linoleic acid content in adults specimens were dependent on the fish rearing site. In general, seabass and seabream fatty acid content was higher in organisms reared in the Sado estuary, when compared to the individuals reared in the Mondego estuary. Carbohydrate analysis showed a significant influence of the rearing site on free sugars and polysaccharide content in fish of both species. Differences in fatty acid and carbohydrates content among juvenile and adult stages were found for all groups studied. The present work supported the existing evidence that semi-intensive rearing systems are subjected to the variability of extrinsic factors, namely the different anthropogenic pressures these systems are subjected to, causing fluctuations in water quality and composition, which may influence the nutritional value of the same species produced in different sites. From a consumer’s perspective, such differences may come as a disadvantage, as it is expected for a product to provide equal nutritional properties and benefits regardless its origin, especially within the same country. From the farmer’s perspective, such vulnerability requires constant monitoring of the extrinsic parameters within the facilities, in order to avoid great losses of the product. Further studies should be conducted to define the parameters that should be regulated and monitored in semi-intensive systems to obtain the best product with the highest food quality.


Intensive aquaculture is considered to be an important source of antibiotics into the marine environment. Antibiotics may cause adverse effects on potentially sensitive organisms such as non-target microorganisms, primary producers or benthic invertebrates. The objective of this study was to evaluate the potential side effects of two antibiotics used in aquaculture (oxytetracycline and flumequine) on the community composition of marine biofilms exposed to these substances and on the shift in the marine environment. Marine biofilms were exposed to 1, 10, 100 and 1000 µg/L of oxytetracycline and flumequine for one week under laboratory conditions. Subsequently, the exposed biofilms were used to feed G. aequicauda organisms for two weeks. The G. aequicauda aquaria set up was run with two treatments in parallel: (1) with input of antibiotics only from the biofilm and (2) with antibiotics administered via biofilm and also spiked into the water. This was done to test different bioaccumulation routes (i.e., ingestion only and water exposure combined with ingestion). All the treatments for biofilm and crustacean test were run in triplicate. Preliminary results show a marginally enhanced biomass growth of the biofilm with increasing dose of both antibiotics,
being this slightly higher in the oxytetracycline test. No correlation was found between antibiotics concentration and elemental composition (analyzed carbon, sulfur and total phosphorous), although nitrogen content was slightly higher in the medicated biofilm. Biofilm arborescence (vertical structures observed through optical microscopy) coverage was statistically different among treatments, showing a non-linear response. Experimental results show that low exposure concentrations contributed to a higher lichen occurrence up to 1000 µg/L, while the highest tested concentrations contributed to a decrease of the biofilm coverage. Ongoing work includes the evaluation of antibiotic’s bioaccumulation in the biofilms, bacterial genetic characterization (microbiome and resistome), diatoms identification, and photosynthetic activity assessment. Regarding the G. aequicunda test, the experimental results do not show an effect over their size or weight by the feeding on antibiotic exposed biofilms. Reproduction and survival were not compromised either. Also bioaccumulation will be analyzed to determine the relevance of each of the evaluated antibiotic exposure routes.

**WE201**

Shifting in the diatom assemblage structure and biological traits of marine biofilms exposed to antibiotics used in aquaculture

N. García Bueno, C. Marín, A. Marín, University of Murcia / Ecology and Hydrology; B. González-Gaya, IMDEA Water (G84912732) / Environmental Chemistry; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology

The use of antibiotics, anti-fouling paints, and fish food are all potential sources of chemical contaminants from commercial aquaculture operations such as fish farms. In particular, antibiotics used in aquaculture have been shown to have harmful effects on aquatic ecosystems. This study aimed to evaluate the effects of antibiotics on marine biofilms exposed to these substances. Biofilms were grown during two weeks under natural conditions on glass slides. Two experiments were conducted in parallel, one in the laboratory and another in the field. In the first experiment, field-grown marine biofilms were exposed to 1, 10, 100 and 1000 µg/L each of a single antibiotic compound for one week and then changes on chemical and biological composition were analyzed. In the second experiment, biofilms exposed to the same antibiotic concentration range were transported to field conditions after two weeks of exposure in order to evaluate their recovery capacity. In both experiments, diatoms were determined to the lowest possible taxonomic level under the microscope (Nikon Eclipse TE2000-U). The taxonomic abundance of the sampled quadrats of each replicate was averaged and referred to the area sampled to obtain the taxon density per replicates. The fine structure of diatoms was analyzed using a scanning electron microscope (JEOL-6100). The diatom composition, the relative abundance of species (%), the Shannon-Wiener diversity index (H’) and the species richness were calculated for each sample and then summarized per treatment. The growth forms (biological traits) of species were analyzed before detachment and were grouped according to the literature. The biofilms were dominated by a reduced number of taxa, including the diatoms Brachysira aponina and Coccosiella phaeentia. High exposure concentrations of oxytetracycline and fluorenone (100 and 1000 µg/L) led to profound deviations in the general diatom groups: Hyalosynedra and Licmophora. The global architecture and traits of the biofilms were also influenced by the high antibiotic exposure concentrations.

**WE202**

Assessing the oxidizing effects of hydrogen peroxide using flow cytometry as a high throughput method

A. Almeida, Norwegian Institute for Water Research NIVA; A. Lillicrap, NIVA / Ecotoxicology and Risk Assessment

Hydrogen peroxide (H₂O₂) is widely used in commercial, industrial, medical, environmental and hygiene applications. It is applied in aquaculture for controlling biological problems such as salmon lice. H₂O₂ produces highly oxidizing radicals that can cause paralysis, peroxidation in organelle membranes and inhibition of enzymes that replicate DNA in biological organisms. The release of H₂O₂ as an effluent into the marine environment is therefore a cause for concern particularly to primary producers such as algae. With the use of flow cytometry, single cells of algae with different features and physiological states, can be examined based on the quenching of flow cytometer laser light and intracellular probes. Cytokinesis enables fluorometric determinations of several parameters such as the ability of reactive oxygen species (ROS) to oxidize non-fluorescent probes to fluorescent products. In the present study, the effects of H₂O₂ on Skeletonema pseudocostatum were analyzed. The method provided a rapid assessment of several endpoints in the same exposed samples. Effects on growth, photopigment and the detection of intracellular ROS production, using 3 molecular probes, were measured over 72 hours. H₂O₂ was used for determining the oxidative burst, DHR 123 for mitochondrial oxidation, and BODIPY FL Dioxygen to determine lipid peroxidation (LPO). Exposure concentrations were selected to cover the overall concentration response curve and a short-term exposure was also made to discern initial high reactivity of H₂O₂. Chemical analyses were performed to verify the stability of the concentrations during the exposure duration. The short-term exposures demonstrated rapid high toxicity of H₂O₂ to algae, where ROS production and the response to the photopigments were the observed endpoints. Over the 72 h, the response of the algae at the different test concentration clearly differed. The accessory photopigments actively responded when the main natural pigments declined. The ROS protective system seemed to be active at medium concentrations, whereas at higher concentrations damage on membranes lipids and mitochondria possibly instigated cell failure. This high throughput approach demonstrated a great potential to study the oxidizing effects of hazardous compounds in algae. While growth inhibition allowed to discriminate the overall toxicity, the high throughput methods, using flow cytometry, helped to screen and characterize the Mode of Action of H₂O₂.

**WE203**

An updated version of the SEPA BathAuto tool for assessing anti-parasitic chemical treatments in marine fish farms

J. Carnall, Cambridge Environmental Assessments; A. Berkeley, Scottish Environment Protection Agency; F. Ericher, CEA; G. Hughes, Cambridge Environmental Assessments

Marine fish farms operators in Scotland wishing to use anti-parasitic chemicals as bath treatments must first obtain a discharge licence from the Scottish Environment Protection Agency (SEPA). Discharge licences are granted by SEPA on a per-site basis, with the quantity of chemical that can be released from a particular fish farm determined by computer modelling. This computer modelling considers the location and composition of the fish farm, along with hydrographic data measured at the site and the toxicity and environmental fate of the chemicals concerned. Discharge quantities are typically calculated for three anti-parasitic chemicals: azamethiphos, cypermethrin and deltamethrin. Of these, cypermethrin and deltamethrin are rapidly removed from the aqueous phase via binding to particles, and are therefore assessed using SEPA’s short-term model, which calculates projected concentrations in the chemical patch up to 6 hours after its release from the fish farm. Azamethiphos, however, remains in the aqueous phase for several days until it is broken down, and is therefore also assessed using a longer-term model, originally developed by Gillibrand and Turrell (1999; MLA Report No 290), and recently extended by Carnall, Ericher and Hughes (2017; poster presentation at SETAC Europe 2017). The SEPA tool BathAuto integrates both the short and long-term models, iteratively performing calculations of chemical concentrations in the water in order to arrive at safe discharge limits for a fish farm. In this poster we present an updated version of BathAuto in which the longer-term model is now fully integrated into the BathAuto tool. The standalone executable required previously for the long term calculations (opendisp.exe) is no longer used, improving the compatibility of the revised tool with modern operating systems. While the standard modelling parameters required by SEPA for discharge licensing in Scotland are included as default, BathAuto could readily be modified to include alternative parameters or chemical data, potentially making this tool available for use in other jurisdictions. The revised version of BathAuto also offers improved graphical outputs, and the ability to calculate several options for compliant cage treatment regimes.

**WE204**

State-of-the-art on the use of models for the ERA of chemicals used in aquaculture


As aquaculture is expanding and becoming a more diverse industry in terms of species and production systems, there is an increasing demand to generate improved modelling tools to assess its environmental impacts. Although important developments have been made in disease prevention and treatment, the use of veterinary medicines and other potentially toxic substances (e.g. antibiotics, man-made products) is still regulated and non-compliance can be used to assess the environmental footprint. This study presents an overview on the use veterinary medicines and other potentially toxic substances used in EU aquaculture, and the environmental standards and regulatory procedures available for their Ecological Risk Assessment (ERA). Furthermore, it describes the state-of-the-art on the development of models capable of assessing the fate, dispersal, exposure, ecological effects and associated ecological risks of veterinary medicines applied in aquaculture production. This study shows that a varied range of models has been developed during the last 30 years. Their effective implementation in regulatory ERA is, however, somewhat limited in many state members. Some recommendations are provided as to improve the chemical exposure assessments and the ecological realism of the modelling outcomes, paying a special attention to the protection goals set for the regulatory ERA of veterinary medicines.

**WE205**

Effects of an aquaculture parasiticide (diflubenzuron) on non-target shrimp
populations: from lab experiments to population-level endpoints


The continued growth of marine aquaculture production has presented the industry with environmental and production concerns, of which the ectoparasitic salmon lice (Lepeophtheirus salmonis) has gradually become a major problem. A commonly used parasiticide against this crustacean is diflunisal (DFB), which acts as a chitin synthesis inhibitor and thereby interfere with the molting stages during sea lice development. However, DFB from the fish feed may also affect non-target crustaceans such as the Northern shrimp (Pandalus borealis), which is an economically and ecologically important species in Norwegian fjords. Laboratory experiments have documented that shrimp exposed to DFB through fish feed have reduced survival (ca. 60%) compared to control, in both the larval and the adult stages. Moreover, the effects of DFB exposure is more severe under future climate conditions (higher temperature). The aim of this study is to make the information on these mechanistic effects more relevant for risk assessment at the population level. We have developed an age-structured population model representing a Northern shrimp population located in a hypothetical Norwegian fjord containing a fish farm, under both ambient and future climates. Our model is based on thorough knowledge of shrimp biology and clear results on toxicological effects from the laboratory experiments. Nevertheless, extrapolating the individual-level effects to the population level poses several challenges. Relevant information on shrimp populations in fjords is sparse (such as abundances, survival and reproductive rates, and their risky-dependent parameters). The degree of exposure to DFB varies at different distances from aquaculture farms is also uncertain. We have therefore developed a set model scenarios representing different medicine application schemes and different degrees of exposure for the shrimp populations. The purpose of the model is to predict effects of DFB exposure on population-level endpoints such as long-term abundance and age structure, and to assess the risk of population decline below threshold abundances.

WE206 Contamination and bioaccumulation of heavy metals in the wild and marine farmed milkfish (Chanos chanos) and mullet (Mugil cephalus) and associated health risk along the coasts of Tanzania

E.B. Mwakalanga, Norwegian University of Life Sciences / Department of Food Safety and Infectious Biology; C.K. Simukoko, University of Zambia; J.L. Lyche, Norwegian University of Life Sciences; M.H. Müller, Norwegian University of Life Sciences / Department of Food Safety and Infectious Biology; A.J. Mmohci, Institute of Marine Sciences University of Dar es salaam; R.H. Mdegela, Sokoine University of Agriculture; M.H. Müller, Norwegian University of Life Sciences / Department of Food Safety and Infectious Biology

Concentration of heavy metals Cu, Pb, Fe, Zn, Cr, Cd, Ni, Al and As were analysed in the muscles and livers of farmed and wild milkfish and mullets from Tanzanian coast. Fish samples were collected from January 2016 to April 2016 and analysed for heavy metals by using Atomic Absorption Spectrophotometer while head and viscera were used for analysis by using ICP AES. The Hazard Quotient (HQ) for Cd at disregard to fish species and in order of decreasing dominance, the overall range of concentrations in (mg/kg ww) of heavy metals were: Fe (< LOD-11.96), Pb (0.54-1.96), Zn ( < LOD-2.81), Cu ( < LOD-2.31), Ni (0.015-0.098), Co ( < LOD-0.086), Cd ( < LOD-0.024, Cr ( < LOD-0.079) and Fe ( < LOD-14.79), Pb (0.92-47.37), Cu ( < LOD-15.08), Zn ( < LOD-12.24), Ni (0.027-0.094), Co ( < LOD-1.0153) in muscles and livers respectively. Al and As were not detected above limit of detection in any of the analysed samples. Metal showed different affinity to muscles and livers of milkfish and mullets, whereas Co and Cd had higher levels in the muscles than in the liver, whereas Pb was exhibited higher in the livers than the muscles of milkfish. In Mullet, Fe, Co, Cr, and Cd levels were higher in the muscles than in the livers, and Pb, Co, Zn, and Ni were higher in livers than in the muscles of milkfish. In Mullet, Fe, Co, Cr, and Cd levels were higher in the muscles than in the livers, and Pb, Co, Zn, and Ni were higher in livers than in the muscles. The concentration of Pb in the muscles of all analysed fish were above the Maximum Recommended Levels (MRLs) by FAO/WHO, EU and USFDA for human consumption. Other metals were below the MRLs. The THQ for all metals were below 1 indicating that the metals are likely to present insignificant health risk to fish consumers. However, based on MRLs recommended by FAO/WHO for human consumption, the levels may pose health risk to human as fish consumer and threatens fish biodiversity. Therefore, this research calls for regular monitoring of heavy metals in fish for consumption and strengthening pollution control measures.

WE207 Poison Toxic and Phototoxic Effects of Benzocyclizone on Crayfish E.N. Vebrosky, Louisiana State University / Department of Environmental Sciences; L.M. Basirico, Louisiana State University; W. Xu, C.G. Lutz, Louisiana State University AgCenter / Renewable Natural Resources; K. Armbrust, Louisiana State University / Environmental Sciences School of the Coast and Environment

Benzocyclizone is the active ingredient in the herbicide, BUTTE®. In 2001, various formulations using benzocyclizone as the active ingredient were approved for use in Japan. It was approved for use in the United States and registered in California as of 2016, and was first applied to rice fields in the 2017 growing season. Benzocyclizone is a photosensitizer that acts as a HPPD inhibitor, leading to the bleaching of weed species to ultimately kill them. With an increase in herbicide-resistant weed species, new formulations of herbicides to combat this in rice fields is advantageous. California is the second largest producer of rice in the United States, with Louisiana as the third largest producer; Arkansas leads the country in rice production. Unlike California, Louisiana has a unique system where rice fields not only grow rice but also grow crayfish for harvest and consumption. The bleached rice fields are prime habitat for crayfish to reside; therefore, crayfish are at risk for exposure to pesticides used in the rice production. Benzocyclizone readily hydrolyzes to benzocyclizone hydrolysat, and therefore it likely undergoes photolysis as well. The potential for toxic or phototoxic impacts of benzocyclizone or its intermediate degradation products to crayfish is important to know for the possible future registration of BUTTE® in Louisiana.

WE208 Effects of the isoflavones, genistein and daidzein, on Acetylcholinesterase from head of Solea Senegalensis. G. Albindín, Universidade de Cádiz (Spain) / Toxicology Area; V. Aranda, University of Cadiz / Toxicology Area; M. Manuel, University of Cadiz / Analytical Chemistry; J. Ortiz, C. Sarasquete, CSIC / Spanish National Research Council; J. Arellano, University of Cadiz / Toxicology Area

The aquaculture is an important economic activity in our area, and one of the main concerns of this sector is fish feed. One of the proposed alternatives to fish meal in feeds are vegetable proteins, and among plant protein sources, soybean is noteworthy. This plant has flavonoidsoincluding the isoflavones daidzein and genistein. Solea senegalensis is a flatfish of high commercial importance both in aquaculture and fisheries in Southern Europe with a wide geographic distribution and availability, and its biological cycle is well known. The aim of this work was to study the effects of the isoflavones, genistein and daidzein, on juveniles (weight 1.23±0.41g) of Solea senegalensis. The 96-h toxicity tests were conducted with continuous aeration and water renewal every 24 hours, at a temperature of 19±2°C and a photoperiod of 12h light/12h dark. Juveniles were exposed up to 20 mg/l genistein and 10 mg/l daidzein. Besides, head AChE activity was not altered in fish exposed to genistein, but daidzein was found to enhance AChE activity at a concentration equal or higher than 2.5 mg/l after 4 days of exposure. Acknowledgements: Authors are grateful to the Laboratory of Marine Culture at University of Cádiz for providing the experimental fish used in this study. This work was supported by National R&D&I Plan Ministry of Economy, Industry and Competitiveness (Project: AGL2014-52906-R) and in part by the Andalusian Plan for Research, Development and Innovation (PAIDI group: RNM-345).

Luminescent biomonitoring via bioassays of different complexity - from cells trough enzyme reactions to proteins (P)

WE209 Comparison between results of LumiMARA and Microtox tests M. LOT, CEBHTA; P. Thomas, CEBHTA SAS; P. Baldoni-Andrey, C. GELBER, F. Mounède, TOTAL SA

In a regulatory context of ever increasing environmental responsibility (OSPAR convention, BREF CWW), there is a need to have biomonitoring tools to evaluate waste water quality. To date, and for several decades, the standard toxicity testing tool used for rapid analysis of waste water has been Microtox®. However, recently a new tool has become available: LumiMARA®, an acute ecotoxicity bioassay which measures the inhibition of luminescence on bacteria in a similar way to Microtox®. Its main advantage is that dark juveniles are exposed at five nominal concentrations of genistein (range 1.25-20 mg/l) and daidzein (range 0.625-10 mg/l), plus an untreated control and a solvent control (DMSO). Mortality was recorded and fish head acetylcholinesterase (AChE) was measured with acetylicholinecl as a substrate after inhibiting butyrylcholinesterase with iso-OMPA. No mortality was observed within the period of the test when the fishes were exposed up to 20 mg/l genistein and 10 mg/l daidzein. Besides, head AChE activity was not altered in fish exposed to genistein, but daidzein was found to enhance AChE activity at a concentration equal or higher than 2.5 mg/l after 4 days of exposure. Acknowledgements: Authors are grateful to the Laboratory of Marine Culture at University of Cádiz for providing the experimental fish used in this study. This work was supported by National R&D&I Plan Ministry of Economy, Industry and Competitiveness (Project: AGL2014-52906-R) and in part by the Andalusian Plan for Research, Development and Innovation (PAIDI group: RNM-345).
in a freshwater environment may be overestimating toxicity of effluents to the freshwater compartment.

**WE210 Bioluminescent assays as tools for studying antioxidant activity and toxicity of bioactive compounds**

A.S. Sachkova, Tomsk Polytechnic University / School of Nuclear Science & Engineering; E. Kovel, Siberian Federal University; N. Kudryashova, Institute of Biophysics SB SAS

This study promotes application of the bacteria-based and enzyme-based bioluminescent assays to evaluate the antioxidant activity of bioactive compounds in oxidizers solutions. Artificial and natural carbon nanostructures – fullerene derivatives, carbon nanotubes (CNTs) and graphene (G) – are used as model oxidizers. The bioluminescence inhibition test was used to determine the EC50 values of these oxidizers decreasing bioluminescence intensity by 50%. The EC50 values of 1,4-benzoquinone were 2.5±10⁻³ M and 10⁻³ M for bacterial and enzymatic assays, respectively, while the EC50 values of K₃[Fe(CN)₆] were 4×10⁻³ M and 2×10⁻³ M. Also we studied the influence of bioactive compounds on the assays. Suppressed bioluminescence of the bacterial and enzymatic systems at concentrations >10⁻⁷ M and >10⁻⁸ M were observed, respectively. Detoxyication coefficients can be calculated to characterize changes in toxicity under the action of bioactive compounds. The values of coefficients >1 and So, the bacteria- and enzyme-based assays showed similar peculiarities of detoxification of oxidizer solutions by bioactive compounds. Results show, that low concentrations of bioactive compounds were active. Our work demonstrates a high potential of the bioluminescent assay systems, bacterial and enzymatic, to characterize and compare antioxidant activity of physiologically active compounds.

**WE211 Effect of low-dose gamma-radiation on luminous marine bacteria Photobacterium Phosphorum**

A.S. Petrova, Krasnoyarsk State Agrarian University / Institute of Agroecological Technologies; D.V. Dementyev, Institute of Biophysics SB SAS / Radiobiology Lab; N. Kudryashova, Institute of Biophysics SB SAS

The study addresses biological effects of low-dose gamma-radiation. Radioactive 137Cs-containing particles were used as model sources of gamma-radiation. Luminous marine bacterium Photobacterium phosphorum was used as a biosensor to test the bioluminescence inhibition by the physiological parameter test. To investigate the sensitivity of the bacteria to the low-dose gamma-radiation exposure (≤250 mGy), the irradiation conditions were varied as follows: bioluminescence intensity was measured at 5, 10, and 20° for 175, 100, and 47 h, respectively, at different dose rates (up to 4100 mGy/h). There was no noticeable effect of gamma-radiation exposure at 10°, while the 20° exposure revealed a detoxyication bioluminescence inhibition. The 20° results of gamma-radiation exposure were compared to those for low-dose alpha- and beta-radiation exposures studied previously under comparable experimental conditions. In contrast to ionizing radiation of alpha and beta types, gamma-emission did not initiate bacterial bioluminescence activation (adaptive response). As with alpha- and beta-radiation, gamma-radiation exposure did not demonstrate monotonous dose-effect dependencies. The bioluminescence inhibition efficiency was found to be related to the exposure time, while no dose rate dependence was found. The sequence analysis of 16S rosomal RNA gene did not reveal a mutagenic effect of low-dose gamma radiation. The exposure time that caused 50% bioluminescence inhibition was suggested as a test parameter for radiotoxicity evaluation under conditions of chronic low-dose gamma-radiation. The detected parameter may be used for quick assessment of photosynthesis condition. A prompt fluorescence that can be registered by PAM fluorimeters is most commonly used for these purposes. Recently, we have developed a more sensitive and fast indicator of the state of the photosynthetic apparatus of plants, which is based on the measurement of delayed fluorescence (DF) of chlorophyll. Delayed fluorescence is registered in red spectrum area after exciting light flashes in the form of time-attenuated radiation. We found out that the ratio of DF excited by high intensity flashes to DF excited by low intensity flashes decreases more than tenfold when there is a toxic effect on photosynthesis. This indicator can be measured within a few seconds. Due to the relative nature of this indicator, which characterizes the photosynthetic activity of the plant test organism, it does not depend on the size or volume of analyzed sample. To implement this method, we developed the Photon 10 fluorimeter which automatically measures the relative indicator of delayed fluorescence (RIDF) in 24 plant samples. Simultaneously with RIDF, the device registers the variable part of prompt fluorescence of these samples. Applying this device we carried out transplanted lichen indication of air pollution in Krasnoyarsk. We found that the values of DF of several species of lichen differed up to 20 times between ecologically clean and industrial areas of the city after three weeks of the exposure. The study of the condition of pine needles in these areas showed a difference in the value of the RIDF up to 5 times. Our method also showed a high sensitivity in bioassay of toxicity of natural and waste waters where Chlorarella vulgaris alga was used as a test organism. RIDF of photosynthesis in suspension decreased by the factor of 2 (2±10⁻² M) in solutions of copper and zinc ions at a concentration of these heavy metals of 0.005 and 0.5 mg/dm³, respectively.

**WE214 Chlorophyll fluorescence temperature curve to estimate changes of the photosynthetic apparatus of coniferous trees during the transition to a state of winter dormancy in urban ecosystems**

N. Pakharkova, Y.S. Grigorev, Siberian Federal University / Department of Ecology and Environmental Study; E. Stravinskene, O. Kryuchkova, N. Pakharkova, Siberian Federal University

Plants have important role in biomonitoring of environmental pollution because of their high sensitivity to various pollutants which often disturb photosynthesis. The photosynthetic function of plants is therefore a good indicator to reveal the pollution effects. Fluorescence of chlorophyll is widely used for quick assessment of photosynthesis condition. A prompt fluorescence that can be registered by PAM fluorimeters is most commonly used for these purposes. Recently, we have developed a more sensitive and fast indicator of the state of the photosynthetic apparatus of plants, which is based on the measurement of delayed fluorescence (DF) of chlorophyll. Delayed fluorescence is registered in red spectrum area after exciting light flashes in the form of time-attenuated radiation. We found out that the ratio of DF excited by high intensity flashes to DF excited by low intensity flashes decreases more than tenfold when there is a toxic effect on photosynthesis. This indicator can be measured within a few seconds. Due to the relative nature of this indicator, which characterizes the photosynthetic activity of the plant test organism, it does not depend on the size or volume of analyzed sample. To implement this method, we developed the Photon 10 fluorimeter which automatically measures the relative indicator of delayed fluorescence (RIDF) in 24 plant samples. Simultaneously with RIDF, the device registers the variable part of prompt fluorescence of these samples. Applying this device we carried out transplanted lichen indication of air pollution in Krasnoyarsk. We found that the values of DF of several species of lichen differed up to 20 times between ecologically clean and industrial areas of the city after three weeks of the exposure. The study of the condition of pine needles in these areas showed a difference in the value of the RIDF up to 5 times. Our method also showed a high sensitivity in bioassay of toxicity of natural and waste waters where Chlorarella vulgaris alga was used as a test organism. RIDF of photosynthesis in suspension decreased by the factor of 2 (2±10⁻² M) in solutions of copper and zinc ions at a concentration of these heavy metals of 0.005 and 0.5 mg/dm³, respectively. This research aims towards a better understanding of the responses of the Scots pine and the Siberian spruce to air pollution stress in urban and semi-urban conditions of Southern Siberia. It is well-established that during the transition from the phase of active photosynthesis into the phase of dormancy, the diameter of the pith and the inner diameter of the pith are found to decrease, while the diameter of the outermost parenchyma of needles undergo a number of changes. Changes in the assembly of the photosynthetic apparatus are mirrored in changes of fluorescence signals emitted at different temperatures. Chlorophyll fluorescence temperature curve (FTC) is a dependence of chlorophyll fluorescence intensity on linearly increasing temperature. This curve is used for determination of the stability of PS2 and for evaluation of the structural arrangement of chloroplasts in vegetating plants. Also, based on the changes in the shape of the FTC it can be deduced whether the plant is in the state of winter dormancy or it is vegetating. The calculated ratio of the low- and high-temperature peaks (50° and 70°) of zero level fluorescence may be used...
as an indicator of the degree of the depth of dormancy. FTC was measured with the needles’ segments using fluorometer Junior-PAM (Walz, Germany). The needles were linearly heated from 25 to 70°C at a rate of 2°C/min using a computer-controlled heating device. In climate conditions of Southern Siberia, disturbance of winter dormancy under air pollution stress represents a major threat to the health status of Pinus sylvestris and Picea obovata. Our data demonstrate that regardless of the age of needles, the depth of winter dormancy of both species clearly correlates with pollution levels, and the trees growing in industrial areas are easier to release from dormancy and to be affected by late winter or spring frost. In urban environments the risk of frost injuries is even higher due to early spring warm spells associated with heat island effect. Scots pine is less susceptible to air pollution and temperature fluctuations than Siberian spruce, and therefore represents a better choice for urban forestry projects.

**WE215**

Luminescent microscopy in the bioindication of the Baikal pollution with oil products and polyaromatic hydrocarbons

M.N. Salyanovsky, A.E. Balayan, Irkutsk State University / Research Institute of Biology of Irkutsk State University; O.A. Barkhatova, Irkutsk State University / Faculty of Geography; A.D. Stom, Irkutsk State University / Research Institute of Biology of Irkutsk State University

Against the backdrop of the growing diversity of toxic substances that degrade the natural environment, the creation of new analytical systems for assessing the state of the environment is of paramount importance. Among such systems a luminescent microscope. It has been experimentally revealed that many pollutants of water bodies, it is necessary to isolate oil products and polyaromatic compounds (PAHs), the flow of which in the valley is constantly increasing. On Lake Baikal, this is due to the development of tourism, the increase in the number of passenger ships and tourist bases, often not equipped with treatment facilities. The necessary system for monitoring the quality of the aquatic environment, including methods for bioindicators, is bioindication, not only on generally accepted test facilities, but also on representative bioindicators for this reservoir. Crustaceans of the order Copepoda, which have well-expressed fatty inclusions in the form of drops, there are several hundred species. Euphausia pacifica (Copepoda, Copepodidae) endemic of Lake Baikal - dwells practically in the entire water column of the pelagic lake. Euphausia pacifica accounts for up to 70% of the total biomass of zooplankton. Crustaceans Copepoda, having fat inclusions, accumulate in them oil products. This can, in particular, be observed by the blue-violet glow in a luminescent microscope. The accumulation of diesel fuel by fatty inclusions of Copepoda crustaceans and the high sensitivity of luminescence microscopy make it possible to detect this pollutant in the water under investigation. It is noted that in the presence of unicellular algae that are absorbed by the crustaceans, this process is activated and the accumulation time of oil products and PAHs decreases. Another representative of the Copepoda Cyclops Colensis also has chaotically scattered fatty inclusions in which the accumulation of oil products can be seen in a luminescent microscope. It has been experimentally revealed that E. baikalensis with oil products or PAHs accumulated in fatty inclusions is added to pure water to C. Colensis, then the staining of fat inclusions also occurs in the latter, that is, this process is transmitted along the trophic chain. Based on these experiments, a method of bioindication on the accumulation of oil products and PAHs in Copepoda crustaceans in fat droplets was proposed.

**WE216**

The correlation between fluorescent properties of water extract from soil and its effect on bioluminescent enzymatic bioassay

E. Nemitzeva, O. Chmurina, Siberian Federal University / Laboratory of Bioluminescent Biotechnologies; M. Gerasimova, Siberian Federal University / School of Engineering Physics and Radio Electronics; V. Krasnov, Siberian Federal University / Biophysical

The work is devoted to the development of the bioluminescent enzymatic bioassay of the soil contamination. The problem of relation of bioassay results with intrinsic properties of the soils or/and the level of their contamination was under consideration. Thus, the concentration and assessment of luminescent characteristics of the various soil samples and the results of their bioluminescent bioassay as well as their physico-chemical characteristics. Water extracts from 56 soils (medium and heavy loams, with humus content 1.2-11.3% and detected arsenic 3.05–15.39 mg/kg) were studied by the method of excitation-emission matrix (EEM) fluorescence spectroscopy. The luminescence in the spectral range of 290-600 nm under excitation at 340-500 nm was recorded for each extract as well as absorption spectra in the range 200-800 nm. The physico-chemical characteristics of the soils (particle size distributions, pH, humus content, etc.) were compared with the inhibitory effect of water soil extracts on enzymatic bioassay based on the coupled bioluminescent reaction of bacterial luciferase and NAD(P)H:FMN-oxidoreductase. It was revealed that the spectral luminescent characteristics of water extracts are similar for all soils and featured by three types of fluorophores with excitation maxima at about 270, 330 and 360 nm and emission maxima at about 330, 425 and 470 nm, respectively. The residual activity of the bioluminescent bioassay enzymes in the presence of soil extracts was found to correlate with intensity of two first bands that is the measure of the component content. Poor correlation was found between EEM characteristics and remaining chemical parameters of the soils including amount of detected arsenic. The conclusion was derived about relation of bioassay signal from studied extracts with the amount of humic substances in soils. The research was supported by the Russian Science Foundation (project no. 16-14-10115).

**WE217**

The comparison of enzyme systems for soil contamination bioassay

E. Kolosov, Siberian Federal University / Biophysical; D. Gulnov, Siberian Federal University; N. Rimatskaia, Siberian Federal University / Biophysical; A. Listisa, O. Sutormin, V. Kratasyuk, Siberian Federal University

Does the soil contamination make it possible to detect the microquantities of this one? A possible example is a model soil with oil products or PAHs added. Another example of the luminescence microscopy make it possible to detect the microquantities of this one? A possible example is a model soil with oil products or PAHs added. Another example is a model soil with oil products or PAHs added.

Another representative of the Copepoda Cyclops Colensis also has chaotically scattered fatty inclusions in which the accumulation of oil products can be seen in a luminescent microscope. It has been experimentally revealed that E. baikalensis with oil products or PAHs accumulated in fatty inclusions is added to pure water to C. Colensis, then the staining of fat inclusions also occurs in the latter, that is, this process is transmitted along the trophic chain. Based on these experiments, a method of bioindication on the accumulation of oil products and PAHs in Copepoda crustaceans in fat droplets was proposed.

**WE218**

Are changes in bioluminescence kinetics of Photobacterium phosphoreum subjected to low-dose radiation connected with genetic mutations?

O. Gaseynov, V. Gaseynova, Siberian Federal University; T. Rozhko, Krasnoyarsk State Medical University. prof. VF Vovyno-Yasnetskiy; A. Bondar, Institute of Chemical Biology and Fundamental Medicine SB RAS; N. Nudryasheva, Institute of Biophysics SB RAS

Luminous bacteria of marine origin are widely employed as biological sensors for monitoring ecological impacts of radiation on living organisms. Due to the use of radioactive elements and related concerns about the increase of background radiation exposure, special attention is lately paid to the effects of low-dose radiation on the environment. The response of bioluminescence reaction to exposures of bacteria to low-dose alpha, beta and gamma radiation has been examined in previous research. The purpose of the current study was to determine whether bacterial genetic alteration is related to bioluminescence kinetics change under low-dose exposure with alpha-emitting (241Am) and beta-emitting (3He) radiocarbons as ions of ionizing radiation. Bioluminescence kinetics of Photobacterium phosphoreum in solutions of 241Am(NO3)3, 7 kBq/L, and tritiated water, 100 MBq/L, were recorded and their stages were determined as follows – absence of effect, activation, and inhibition of enzymatic catalytic activity. The inhibition of bioluminescence kinetics by different stages of the bioluminescence kinetics ensuring that the doses accumulated by the samples were close or a little higher than a tentative limit of a low-dose interval: 0.10 and 0.85 Gy for 241Am, or 0.11 and 0.18 Gy for 3He. The 16S ribosomal RNA gene was chosen as a target one for sequence analysis aimed to test whether low dose radiation triggers any alterations in this universal throughout bacterial world and remaining chemical parameters of the soils including amount of detected arsenic. The conclusion was derived about relation of bioassay signal from studied extracts with the amount of humic substances in soils. The research was supported by the Russian Science Foundation (project No. 16-14-10115).
LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (P)

WE219
Meet the Framework Regulation and Supply Chain secondary standards in wheat cultivation for sustainable pasta production. An example of broadleaf weed control: haluxifen-methyl (Arylex™ active)
C. Vaj, S. Cavanna, Dow AgroSciences Italia srl; A. Haley, Dow AgroSciences Ltd; W. Jones, DuPont

The need and awareness of sustainable food production has increased in recent years. The growing awareness of global population increase and its burden on the limited agricultural land available to sustain the required food production. This is being reflected in the choices made at all the steps of food production from field to table. The sustainable production of pasta starts by optimising agricultural practices, which includes the key component of Plant Protection Products (PPP) applied to wheat crops. The development of new Plant Protection Products in Europe is governed by the strictest regulatory framework in the world: Regulation (EC) 1107/2009 concerning the placing of plant production products on the EU market; Directive 2009/128/EC on Sustainable Use of pesticides and its national implementations (National Action Plans), and Regulation (EC) 396/2005 concerning the Maximum Residue Levels of plant protection products allowed in food. In addition, the Secondary standards coming from Food Processors and Retailers regarding chemical residues in food place increasing standards which have to be considered. The Plant Protection Industry is increasing its focus on sustainable food production not only for complying with the evolving Regulations, but also for helping the farmer to meet the Food Supply Chain needs. A good example of this new emphasis is brought by an innovative auxinic herbicide, haluxifen-methyl (Arylex™ active), for use in broadleaf weed control (LCA study); and (2) to compare the environmental impacts of an EGR mock-up to a traditional gravel ballasted roof (TGR) mock-up. In this research, the Life Cycle Inventory was modelled using the SimaPro 8.3.0 software and the Ecoinvent database, and the IMPACT 2002+ methodology was selected as the Life Cycle Impact Assessment method. Vegetative roofs seem like a possible solution for the environmental issues in Lebanon since this small Mediterranean country lacks a clear sustainability plan as well as an infrastructure update and only 13.4% of the total surface area (10,452km²) are forested area. Vegetative roofs embellish the unused roof surface available in most urban areas, increase the roof lifetime, reduce the need for a heating/cooling system as a result the building energy consumption is decreased, etc. Vegetative roofs capture a fraction of the rainwater through their growing material and the vegetation could remove airborne pollutants. The findings of this research seem to be very promising, the extensive green roof mock-up has the least environmental impacts for all impact categories except for the “land occupation” impact category due to the vegetation layer. Moreover, a real-time monitoring of temperature was done to assess the electricity consumption or both TGR and EGR mock-ups within the use phase. Furthermore, the sensitivity and uncertainty analyses will be performed to check the robustness of the results.

WE220
Cradle to grave Life Cycle Assessment of Traditional and Vegetative roofs
J. Koura, University of Balamand / Chemical engineering department; R. Bhalnu, University of Balamand / Department of Chemical Engineering; R. Belarbi, University of La Rochelle / Laboratory of Engineering Science for Environment LiSEI; E. El Khoury, University of Balamand / Chemical engineering department; H. El Zakheim, University of Balamand / Department of Chemical Engineering; M. El Khouby, University of El Kawar, University of Balamand / Chemical engineering department

The aims of this study are to (1) assess the environmental performance of an extensive green roof (EGR) mock-up installed on the rooftop of the Chemical Engineering Department at the University of Balamand, in the region of El Kurah, North Lebanon (34°31’N, 35°50’E) from the raw material phase until the end-of-life phase; through a rapid Life Cycle Assessment (LCA) study; and (2) compare the environmental impacts of an EGR mock-up to a traditional gravel ballasted roof (TGR) mock-up. In this research, the Life Cycle Inventory was modelled using the SimaPro 8.3.0 software and the Ecoinvent database, and the IMPACT 2002+ methodology was selected as the Life Cycle Impact Assessment method. Vegetative roofs seem like a possible solution for the environmental issues in Lebanon since this small Mediterranean country lacks a clear sustainability plan as well as an infrastructure update and only 13.4% of the total surface area (10,452km²) are forested area. Vegetative roofs embellish the unused roof surface available in most urban areas, increase the roof lifetime, reduce the need for a heating/cooling system as a result the building energy consumption is decreased, etc. Vegetative roofs capture a fraction of the rainwater through their growing material and the vegetation could remove airborne pollutants. The findings of this research seem to be very promising, the extensive green roof mock-up has the least environmental impacts for all impact categories except for the “land occupation” impact category due to the vegetation layer. Moreover, a real-time monitoring of temperature was done to assess the electricity consumption or both TGR and EGR mock-ups within the use phase. Furthermore, the sensitivity and uncertainty analyses will be performed to check the robustness of the results.

WE221
Filling whole building life cycle assessment gaps for conceptual building design
Y. Han, University of Pittsburgh; J. Chhabra, G. Warn, Pennsylvania State University; M. Bilec, University of Pittsburgh / Civil and Environmental Engineering

Resource consumption, harmful emissions, climate change, and hazard events have triggered increased interest in sustainable and resilient buildings over the past 20 years. The sustainability and resilience performance of buildings has been covered in numerous rating systems and building codes; however, these are typically prescriptive methods focused on setting minimum performance requirements rather than helping us understand and optimize buildings. Life cycle assessment (LCA) and performance-based methods (e.g., energy modeling, seismic loss assessment) can be more beneficial from this standpoint but can be complex and isolated from each other. Most building LCA studies to date have limited their scope to embodied and operational energy use, due to their overwhelming impacts in conventional buildings, while some aspects, such as repair from damages (e.g., seismic) and water use have been largely missing. This study uses LCA, energy modeling, water modeling, and seismic loss assessment simultaneously to obtain a comprehensive evaluation of the costs and life cycle impacts of different building design alternatives. Preliminary analysis of a hypothetical building shows that in some metrics, such as cost and eutrophication, repair and water phases, respectively, can contribute more than 10% over the lifetime of the building. One design parameter expected to influence all of the mentioned performance aspects is the building form-factor, and its effect on the results will be presented. Based on the typical approach to building LCA and the shift in the sources of impacts away from operational energy as buildings transition to net-zero energy, this study investigates the potential contribution from missing phases in building LCA. This research brings together knowledge from multiple disciplines and links them through life cycle thinking, investigating the effects of building design decisions in multiple metrics. This approach can be crucial in identifying optimal solutions early on during the conceptual building design phase.

WE222
Prospects for multidimensional assessment of sustainability in urban environments
F. García-Guinea, L. Lijó, Universidad de Santiago de Compostela / Chemical Engineering; A. Núñez, L. González Lourou, FEGAMP - Santiago de Compostela; E. Andrade, Universidade de Santiago de Compostela; M. Moreira, G. Feijoo, University of Santiago de Compostela / Chemical Engineering; S. González-García, University of Santiago de Compostela CIF Q1518001A / Chemical Engineering

Urban systems can be considered as living organisms driven by materials and energy flows (urban metabolism). Once these flows are computed, the environmental profile of the city can be analysed. However, when only assessing the environmental aspects of cities, a limited view of their performance is possible, as they are complex systems in which social and economic aspects are at least as important as environmental ones. This fact raises a dilemma, since today’s developed society bases its social and economic well-being on the sustainable production not only for complying with the evolving Regulations, but also for helping the farmer to meet the Food Supply Chain needs. A good example of this new emphasis is brought by an innovative auxinic herbicide, haluxifen-methyl according to its label offers wheat growers a key tool for optimizing production, while producing a commodity with no detectable residues in the grain, in the processed product (bread, wheat germ, malt) in and in pasta. Results will be presented and discussed. Therefore, the properties of haluxifen-methyl are fully aligned with increasingly strict environmental requirements from regulatory authorities and the Food Chain Secondary standards. TM-Trademark of Dow AgroSciences

WE223
Life Cycle Analysis of remediation solutions in railways and surrounding areas
M. Riera, Leitat Technological Center

An important environmental problem is the pollution associated with trains on external or underground railways. Despite is an issue less studied, a real contamination by heavy metals and hydrocarbons exists in railways, affecting also the surrounding areas. Following the strategic line of Horizon 2020, RECOVER project aims to develop new technologies to reduce the environmental impact of transport systems. The project is executed by COMSA, CETIM and LEITAT, and is within the framework of the call “Challenges of Collaboration” in 2015, with partial funding from the Ministry of Economy and Competitiveness of Spain. The
main aim of the project is to develop systems for the collection and elimination of pollutants (hydrocarbons and heavy metals) present in the ballast and on the ground adjacent to the railway tracks through the use of different technologies: Ballast modified by sol-gel coating based on silicon oxide to capture heavy metals and titanium oxide for the degradation of hydrocarbons. Phytoremediation processes (use of plants to decontaminate soils) and bioremediation (bioaugmentation of the microbial population of the soil) for the uptake of heavy metals and hydrocarbons in the soil adjacent to the roads. The solutions are first performed at the laboratory scale, and subsequently they are located in a real area to evaluate their effectiveness. The remediation procedures are assessed through a comprehensive Life Cycle Assessment (LCA) to identify the environmental benefits obtained with the introduction of the solutions in railways. The environmental analysis includes the life cycle stages of raw materials, production, transport, and end of life sequences, including transport and other related aspects. The LCA is performed based on the methodology which is standardized by the ISO 14040 and ISO 14044. Calculations are done using the SIMAPRO software and taking as a basis the Ecoinvent3.1 database. Besides the direct environmental benefits of the pollutants reduction in the soil, the LCA allows the identification of other environmental aspects. The impact categories and indicators that should be included are: Acidification, Depletion, Photochemical Ozone Formation, Acidification, Terrestrial and Freshwater Eutrophication, and Freshwater Ecotoxicity. The pollution due to rail transport is a problem identified in Member state of the European Union, the solutions proposed in RECOVER project could an important contribution to the current railway legislations.

WE224 Life Cycle Assessment of Asphalt Mixtures vs Road Pavements

D. Lo Presti, The University of Nottingham / Nottingham Transportation Engineering Centre NTEC; A. Jimenez del Barco Carrion, The University of Nottingham

Road infrastructures are one of the major assets all over the world. The appropriate construction and maintenance of roads promote economic growth and development of countries. Within the field of road infrastructures, road pavements construction and maintenance require particularly high energy and raw materials consumption and generate elevated GHG emissions. For this reason, great efforts are being made in the last few years to improve the implementation of sustainable techniques and operations, and decision-making tools are essential to help authorities to accept them. In this regard, LCA has become popular in pavement engineering but there is still a lack of detailing, consensus (especially in terms of system boundaries) and reliable data. Beyond ISO 14040:2006, ISO 14044:2006, ISO/TS 14067:2013, EN 15804:2012 and GHG Protocol 2013, there is no specific methodology for selecting the process and activities that should be included in either road or asphalt mixtures LCA. LCA of road pavements is a complex process which needs the collaboration of the different partners involved, such as road authorities or contractors, to provide information, and therefore there exists a common tendency to simplify the LCA of pavements and individually analyse their components - usually asphalt mixtures. This process is not always clarified and may lead to erroneous conclusions or incoherent procedures. In order to use LCA for decision-making in asset management, it must be more related to road pavements rather than asphalt mixtures. In other words, the LCA of the pavement components (e.g. asphalt mixes) should be a mere input and the overall methodology should focus mainly on dealing with data such as road geometry, maintenance strategies, traffic, pavement conditions and statistical parameters to account for data changing over time. This study presented a new analysis that aims at highlighting the differences between the LCA of asphalt mixtures and road pavements. For this, the different phases of LCA are defined and analysed for the systems respectively. Finally, system boundaries are proposed for each system in order to move towards LCA of road pavements and standardised methodologies.

WE225 Sustainability assessment of an integrated innovative wastewater and greywater system for an optimal and safe closed water cycle in Mediterranean tourist facilities: demEAUmed solution

A. Claret, C. Hidalgo, Leitat Technological Center / Sustainability Division; S. Vercher, Leitat TECHNOLOGICAL CENTER / Engineering; J. Alonso TAPIA, LEITAT TECHNOLOGICAL CENTER / Sustainability Division

The main objective of demEAUmed is to tackle water scarcity in the Mediterranean area, especially in places with high tourist activity. Also, the project wants to foster the incorporation of sustainability aspects in the tourism sector. To achieve both challenges, demEAUmed has demonstrated the integration of innovative wastewater/greywater technologies to achieve an optimal and safe closed water cycle in Mediterranean tourist facilities. Water resources are limited and unevenly distributed geographically and among the year seasons, with higher pressure during summer, in Mediterranean regions. For instance, water consumption per guest has been estimated at 222 L/day in hotels in Spain. So, it is of great importance to achieve a holistic water resource management. demEAUmed affords the reuse of greywater and wastewater generated in touristic facilities with an integrated approach bringing environmental benefits such as water savings and water management carbon footprint reduction. 8 different innovative technologies with an advanced monitoring, control and decision support system have been integrated and implemented on the demonstration site: Samba Hotel-Lloret de Mar, Catalonia, Spain. These technologies have been assessed through a comprehensive LCA, assessing the impacts for each individual technology and for the demo-site integration (7 different configurations). Besides the LCA, a Life Cycle Costing (LCC) is being performed in order to analyse the economic costs. A social LCA (S-LCA) is also conducted in order to assess the social impacts generated by demEAUmed. Life cycle stages of construction and operation of technologies and systems are considered, allowing a life cycle perspective over the analysis period. The study presented here aims at highlighting the most effective remediation procedures are assessed through a comprehensive Life Cycle Assessment (LCA) to identify the environmental benefits obtained. In order to move toward the implementation of sustainable technologies and systems, the introduction of the solutions in railways but there is still a lack of detailing, consensus (especially in terms of system boundaries) and reliable data. Beyond ISO 14040:2006, ISO 14044:2006, ISO/TS 14067:2013, EN 15804:2012 and GHG Protocol 2013, there is no specific methodology for selecting the process and activities that should be included in either road or asphalt mixtures LCA. LCA of road pavements is a complex process which needs the collaboration of the different partners involved, such as road authorities or contractors, to provide information, and therefore there exists a common tendency to simplify the LCA of pavements and individually analyse their components - usually asphalt mixtures. This process is not always clarified and may lead to erroneous conclusions or incoherent procedures. In order to use LCA for decision-making in asset management, it must be more related to road pavements rather than asphalt mixtures. In other words, the LCA of the pavement components (e.g. asphalt mixes) should be a mere input and the overall methodology should focus mainly on dealing with data such as road geometry, maintenance strategies, traffic, pavement conditions and statistical parameters to account for data changing over time. This study presented a new analysis that aims at highlighting the differences between the LCA of asphalt mixtures and road pavements. For this, the different phases of LCA are defined and analysed for the systems respectively. Finally, system boundaries are proposed for each system in order to move towards LCA of road pavements and standardised methodologies.

WE230 Streamlined life cycle assessment of emerging batteries in early design phases using CCaLC tool

C.C. Tomasin-Montenegro, KIT, Karlsruhe Institute for Technology; M. Wei, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis ITAS

Tomasini-Montenegro, C. Wei, M. N. 6. HHU, Helmholtz-Institute Ulm, Germany. b ITAS, Institute for Technology Assessment and Systems Analysis, Karlsruhe, Germany. c KIT, Karlsruhe Institute for Technology, P.O. Box 3640, 76021 Karlsruhe, Germany. In our modern and globalized society, meeting energy needs in a sustainable way pose one of the biggest challenges for the scientific, political and regulatory bodies around the world. Therefore, in the context of the United Nations Development Goals, affordable and clean energy access has been defined as a reachable goal for 2030. In addition to the social impacts associated with this action plan, both tackling climate change and defining regulatory and market frameworks are common elements to identify global solutions for a low carbon energy market. Although it is recognized that geopolitical factors will shape a tailored solution for each geographical region, a transformation of the energy system with a high share in renewable energy sources is necessary to reach a decarbonized energy supply. In particular, considering an energy system with share of solar and wind power, energy storage technologies are required to level fluctuating energy production and demand. However, even though it is recognized that the energy storage technologies exhibit different maturity stages, information about their associated environmental impacts is expected to be a significant aspect of the overall sustainability analysis. Therefore, in order to obtain environmental burdens shifting, a life cycle perspective approach is proposed to develop a model for the preliminary evaluation of emerging batteries or components of these batteries using CCaLC as an assessment tool. The outcome of this work is aimed at contributing to understanding the environmental impacts associated with batteries from a life cycle perspective, while evaluating the advantages and disadvantages of using CCaLC as an assessment tool.

WE232 Development of Environment Hotspots of Analysis and the consideration of availability of eco-labeling program

Y. KURAHARA, N. Isuibo, Tokyo City University

In 2014, the UNEP/SETAC life cycle initiative published a guidebook regarding hotspots analysis which enables to extract important elements from the life cycle. They defined this method as “a methodological framework that allows for the rapid assimilation and analysis of a range of information sources, including life cycle based studies, market, and scientific research, expert opinion and stakeholder concerns. The outputs can be used to identify potential solutions and prioritize actions around the most relevant economic, environmental, ethical and social sustainability impacts”. Therefore, the scope of hotspots analysis covers environmental and social aspects. The methodology of environmental hotspots analysis has been developed in Japan using latest Japanese inventory database IDEAS2 and WIO (Waste Input Output table) and the environmental impact assessment method (ILME). The most recent version of this tool is based on the use of the calculation tool. However, the case number of studies using hotspots analysis tool are few, advantages and limitations are unknown. In this research, the usefulness of environmental hotspots analysis through a variety of case studies for Japanese products.

WE228 Life Cycle Assessment of Pharmaceutical Waste Disposal in the UK

S. Mohamed Yunus, University of York / Environment; A. Boxall, University of York / Environment Department; E. Igos, Luxembourg Institute of Science and Technology / Environmental Research and Innovation

Unused or expired medicines from the hospital and household waste can ultimately end up in landfills or be released to the wastewater system. Therefore, there is the potential for active pharmaceutical ingredients (APIs), from a range of medicinal products, to be present in landfill leachate and sewage effluents. Unused medicines may also be returned to the pharmacist and then be incinerated as hazardous waste. In this project, a household survey was performed to understand the typical waste generation patterns for medicines and the most disposal routes for these substances in the UK. The results show that rubbish disposal (34%) is the common disposal method by UK residents with highest estimated emission of APIs to the environment being estimated for paracetamol within the range 7.63 mg/person/day (sewage after sink and toilet disposal) to 76.52 mg/person/day (wastewater after excretion). Based on the survey data, a life cycle assessment study was performed to assess the broader environmental impacts of typical medicinal waste disposal management practices in the UK. The functional unit of this study was 1 tonne of pharmaceutical waste generated in the UK. Three scenarios and treatments explored: incineration after returning back to the pharmacy; landfill treatment after rubbish disposal; and wastewater treatment after toilet and sink disposal. For the life cycle inventory (LCI) phase, two types of databases were used in the study: primary data from the survey study and secondary data from the ecoinvent database. Most of the datasets used in this study are from the whole of Europe (ERB) or the United Kingdom (GB). To carry out the life cycle impact assessment (LCIA) phase, the method that has been considered is LCID 1.08 2016 midpoint with APIs. Meanwhile, USETox 2.0 was also used in this study to calculate characterisation factors for the APIs that were not commonly used in the previous study. Furthermore, the impact categories that were considered for this study are climate change, ecosystem quality, human health and resources. The study is still ongoing and the results will be presented at the event.

WE223 Environmental burden reduction in the FTA framework using network analysis

S. Tokito, Kyushu University

The CO₂ emissions embedded in international trade have rapidly increased in countries with lax environmental regulations with expansion of trade and the emission from China and Russia as well as TPP member (Lee, 2015). In addition, with the improvement of environmental efficiency at industry level of a specific country, it is important to corporate within well-specified industrial clusters through supply chain engagement over developing and developed countries (e.g., Kagawa et al., 2015). Moreover, with expansion of trade and the international fragmentation of productions, the promotion of free trade has been increasingly required. In this circumstance, mega-regional Free Trade Agreement have been identified as a significant trade policy issues. For countries participating the FTA framework, it is important to promote economic growth and reduction in various environmental burden simultaneously through the cooperation between the participating countries. To decide the cooperation policy for reducing environmental burden, it needs to understand the structure of complicated supply chain network. However, to the best of our knowledge, previous studies did not analyze the supply chain network induced by the production and consumption of FTA member countries. This study used the network centrality analysis, especially, the applied structural path betweenness (Liang et al., 2016; Hanaka et al., 2017) to EORA database (Lenzen et al., 2012, 2013) and analyzed the critical sectors for the cooperation policy in the global supply chain network. From the centrality analysis, it identified the critical sectors and transmitters. In the case of TPP framework, the largest CO₂ emitter are “JPN, Electricity, Gas and Water” and “CHN, Electricity, Gas and Water.” On the other hand, the largest CO₂ transmitter are “RUS, Mining and Quarrying—JPN, Petroleum, Chemical and Non-Metallic Mineral Products” in the sector level and “CHN—JPN” in the country level. We can see the large CO₂ emissions come from China and Russia while “CHN—JPN” transmits the largest CO₂ emissions.

WE224 Developing life cycle assessment to fight climate change

P. Goglio, Cranfield University / School of Water, Energy and Environment; A.G. Williams, N. Balta-Ozkaz, N. Harris, Cranfield University / School of Water, Energy and Environment; P. Williamson, University of East Anglia / School of Environmental Sciences; A. Marvuglia, Luxembourg Institute of Science and Technology (LIST) / Environmental Research and Innovation (ERIN); P. Baustert, Luxembourg Institute of Science and Technology LIST / Resource Centre for Environmental Technologies (CRTE)

Climate change targets could only be achieved with the contribution of greenhouse gases (GHG) from several GGRT. Several GGRT have been identified: i) burning waste materials such as direct coal carbon capture and storage (CCS), the use of wet raw materials in cement production, enhance weathering, enhancing soil C; forest management; bioenergy from woody wastes; and ii) replacing existing fossil-based production, enhance weathering, enhancing soil C; forest management; bioenergy from woody wastes. Therefore, there is no consensus on the methodology to assess GGRT, with expansion of trade and the international fragmentation of productions, the promotion of free trade has been increasingly required. In this circumstance, mega-regional Free Trade Agreement have been identified as a significant trade policy issues. For countries participating the FTA framework, it is important to promote economic growth and reduction in various environmental burden simultaneously through the cooperation between the participating countries. To decide the cooperation policy for reducing environmental burden, it needs to understand the structure of complicated supply chain network. Therefore, in order to understand structure of the supply chain network, this study uses the network centrality analysis, especially, the applied structural path betweenness (Liang et al., 2016; Hanaka et al., 2017) to EORA database (Lenzen et al., 2012, 2013) and analyzed the critical sectors for the cooperation policy in the global supply chain network.
models in consequential LCA. None of the approaches presented resulted fully comprehensive, with limited uncertainty and complexity. Both approaches based on agent based modelling require a large amount of data and expertise to be used, not often available to the LCA practitioner. The weighted consequential approach has a level of subjectivity higher than other approaches. Instead, the scenario based approach using IAM has a medium level of completeness, uncertainty and complexity. However, it is based on a strong agreement with the IAM assumptions to be used and this constitutes a major limit.

The choice among the approaches depends on the objectives of the LCA and should be as complete and comprehensible as possible when climate change claims are made. Future perspectives include a comparative testing of these approaches for selected GGRT and future research should develop and assess potential alternative approaches to those presented. Further research is necessary to develop the appropriate LCA methodology for GGRT.

**WE235**

**HYBRID FULFILMENT-IMPORTANCE MATRIX FOR ASSESSING SOCIOECONOMIC IMPACT**

I. Espit Gallart, Fundacio CTCM, Centre Tecnologic; I. Bezova, L. Vendrell, Fundacio CTCM Centre Tecnologic More often, methodologies to assess socioeconomic impact are focused just on determining just a few indicators instead impacts, which don’t use to cover the whole spectrum of socioeconomic insights. In this sense, the hybrid fulfilment-importance matrix emerges with the aim to solve these limitations and to cover the full spectrum of the project, which socio-economic and environmental life cycle impacts of a new process, project or service. This methodology is not only based in technical performance of the studied system, but also in the holistic approach offered by the LCA, LCC and sLCA methodologies. This semi-quantitative system is based on the scores of the relationship between indicators and impacts. In this way, this methodology allows calculating in which degree the objectives have been achieved, and how the impacts and indicators affect the system. The indicators, data collected in the form of a system is the integrated approach which allows to consider the impacts of the project during different dimensions of the project. The indicators, placed in rows, are organized in four categories: environmental indicators, socio-economic indicators, economic indicators, and social indicators. For technical indicators, data coming from performance of the system is implemented. The indicators for the environmental category are taken from LCA studied impact categories, which are supposed to be relevant for the project. In the case of the economic category, indicators studied in the LCC study are considered. Regarding the social indicators, those listed come from sLCA study. The distribution of the columns shows two parts: the fulfilment part, and the relevance part. In the fulfilment part, three columns are deployed: Baseline status, expected results set with the goals of the new process, and current or final results. On the importance part, the added columns represent the impacts of the project, which entail technical, sustainability, economic and social insights. When the impacts are selected, its importance in relation to the studied indicators must be defined based on expert know how and opinion. This importance is set by applying a value between 0 and 3. The socio-economic scores are calculated combining the importance values with the fulfilment for the indicators. As a case study, this methodology has been applied to LIFE RELEACH project, which is aimed at managing leachates coming from landfill by concentrating technologies. In this way, the methodology has allowed to determine which socio-economic impacts have the higher contribution.

**WE236**

**SETAC Sustainability Interest Group**

D.L. Carr, Texas Tech University / Biomedical Sciences

**WE237**

**SETAC LCA Interest Group (Europe)**

H. Stichnothe, Thünen Institute / Agricultural Technology

**WE238**

**Life cycle assessment of a thermoplastic starch obtained from mango kernel**

A. Carneiro, Environmental Research Corporation / Embrapa Agroenergia; P. Marques, P. Freire, University of Coimbra / ADAI-LAETA, Mechanical Engineering; P. Melo, Federal University of Ceará; M. Figueiredo, Brazilian Agricultural Research Corporation Embrapa / Embrapa Tropical Agroindustry

Agricultural industry generates large amounts of residues with potential to be used as feedstocks for bio-based products. Mango fruit annual production in Brazil is expected to increase to 1.4 million tons by 2024, and processing residues can account for more than 40%. The mango pulp is the main product, and mango kernel, a so-called residue, is disposed of at landfill, but containing starch, oil and phenolic substances. This study assesses the environmental life cycle impacts of thermoplastic starch produced from mango kernel (MKTPS), and compares it with fossil-based low-density polyethylene (LDPE). The system boundaries of the MK-TPS start with transportation of mango kernel residue, followed by extraction of starch from mango kernel (together with oil and phenolic substances), and production of thermoplastic. The functional unit adopted was 1 kg of thermoplastic.

A life cycle inventory for MK-TPS was implemented based on primary data gathered at a laboratory scale. Six environmental impact categories were assessed based on the ReCiPe life cycle impact assessment method. A sensitivity analysis to the allocation approach for the starch extraction process will be performed comparing mass allocation (56% starch, 28% phenolic compounds and 16% oil) with economic allocation (using a range of expected market prices). Impacts based on this allocation for MK-TPS show lower climate change, fossil depletion and ozone depletion, but higher impacts on terrestrial eutrophication and marine eutrophication, comparatively to LDPE. The most important contributor to impacts is starch extraction (due to hexane and methanol), except for marine eutrophication, for which the main contributor is glycerin used to produce the thermoplastic. The paper may contribute to the eco-design of a new bio-based product using an abundant residue from the fruit industry, as feedstock, through a Life cycle assessment based on laboratory scale data. Future studies shall take into consideration critical aspects and improvement opportunities identified through the study on a larger scale extraction process.

**Environmental monitoring of contaminants using terrestrial ecological biomonitor**

**WE239**

**Geostatistically estimating spatial structures of heavy metals and nitrogen accumulation in mosses sampled between 1990 and 2015 throughout Germany**

R. Assemissa, W. Schröder, University of Veterinary / University of Veterinary, University of Veterinary / University of Veterinary, University of Veterinary

Mosses are used to spatially complement the collection of atmospheric deposition by technical samples and to validate deposition modelling results. Since 1990, the European Moss Surve technique has being data on element concentrations in moss every five years at up to 7300 sampling sites. In the moss specimens, heavy metals (since 1990), nitrogen (since 2005) and persistent organic pollutants (since 2010) were determined. Germany participated in all surveys with the exception of one in 2010. In this study, the spatial structures of element concentrations in moss collected between 1990 and 2015 in Germany were comparatively investigated by use of Moran’s I statistics and Variogram Analysis and mapped by use of Kriging interpolation. This is the pre-condition to spatially join the moss survey data with data collected at other locations within different environmental networks. The case study maps reveal a clear and statistically significant decrease of concentrations of most heavy metals in moss but not for nitrogen. Due to decreasing element concentrations and the unchanged application of the element concentration classification for the mapping, the heavy metals maps for the survey 2015 do not any longer depict much spatial variation. Therefore, in an upcoming study, this analysis needs to be complemented for the heavy metals by mapping percentile statistics for the whole period 1990-2015 with maps depicting the spatial structure of survey-specific percentile statistics 1990, 1995, 2000, 2005, and 2015.

Development Fund (ERDF), through COMPETE2020 – Programa Operacional Competitividade e Internacionalização (POCI) and by national funds, through FCT - Fundação para a Ciência e a Tecnologia; (ii) NORT-E-01-014-FEDER-000005-LEPABE-2-INOVATION, supported by North Portugal Regional Operational Programme (NORTE 2020), under the Portugal 2020 Partnership Agreement, through the ERDF; (iii) Investigator FCT contract IF/01101/2014 (Nuno Ratola).

WE241 Study of global diffuse pollution levels in remote high mountain areas and their impact on the organisms from these ecosystems

R.M. Prats, Institute of Environmental Assessment and Water Research (IDAEA-CSIC) / Environmental Chemistry; B.L. van Drooge, IDAEA-CSIC / Department of Environmental Chemistry; P. Fernández, B. Pita, J. Grimailt, Institute of Environmental Assessment and Water Research IDAEA CSIC / Department of Environmental Chemistry

Global diffuse pollution results from the emission of multiple sources and long-range transport. Effects of this background contamination have been observed in the recent past in fish from remote high mountain lakes through mRNA measurements in which showed feminization effects and oxidative stress (S. Jarque et al. 2015). Although some of these effects were related to persistent organic pollutants, there is still a gap of knowledge on their toxicological mechanisms and possible influence of other chemical pollutants. Persistent organic pollutants are incorporated to remote high mountain areas through atmospheric transport and deposition, where they are bioaccumulated, depending on the physical-chemical properties of the pollutants, they may bioaccumulate. A comprehensive study of the pollutants in the atmosphere, lake waters and fish is presented in the present work. The six remote high mountain lakes investigated were located in the National Park of Aigüestortes i Estany de Sant Maurici (Pyrenees). They encompassed an altitudinal gradient from 1600m to 2500m asl. Active and passive monitoring devices were used for air and water sampling in order to get insight on the presence and environmental fate of organic contaminants over an extended time period. Moreover, brown trout (Salmo trutta) specimens were captured in each lake for bio-monitoring. They were analyzed for contaminants in the muscle, hepatopancreas and gallbladder tissue. The transcriptomic and proteomic analysis of mRNA was also performed to link the levels of pollutants found in these remote high mountains to the effects in these organisms. The observed concentrations will also be compared to past measurements in other high mountain environments for assessment of temporal trends of this background contamination. S. Jarque et al. (2015). Background fish feminization effects in European remote sites. Sci. Rep., 5, 11292.

WE242 Spatial distribution of mercury and trace metals in epiphytic lichens in Nova Scotia, Canada

S. Klapstein, Acadia University / Earth & Environmental Science; I. Carvalho, Técnico Lisboa; R. Cameron, Nova Scotia Provincial Government / Department of Environment, where they: Act as be a university for ecology departmen; xcombs, Acadia University / Chemistry; C.H. Saunders, Acadia University / Biology department; J. Canario, Instituto Superior Técnico / Centro de Química Estrutural; R. Keenan, Environment and Climate Change Canada; N.J. O’Driscoll, Acadia University / Department of Earth and Environmental Science

Mercury is a persistent pollutant present in all ecosystems. The prevalence and spatial distribution of mercury will determine its movement in the atmosphere and potential to bioaccumulate and biomagnify through food webs leading to mercury contamination in top predator organisms. Monitoring of mercury and other trace metals can be costly, whereas the use of naturally occurring epiphytic lichens can be an effective tool for these types of studies. Nova Scotia, Canada is a hotspot for mercury and other trace metal accumulation in ecosystems, partially attributed to long-range transport of anthropogenic air pollution. The region also contains a number of historic gold mining sites that are known to have persistent high levels of mercury and arsenic in sediment. The relative contribution of local and national sources of mercury to local air is unknown. This work aimed to address which elements can be effectively biomonitored through lichens. Trace metals in lichens other than mercury may also help elucidate the potential sources of these elements: whether from geological, re-emission, or long-range transport. Over 300 lichen (Usnea spp.) samples were collected across Nova Scotia and analyzed for total mercury (THg); a subset of these samples were analyzed for other trace metals, including arsenic, nickel, copper, cadmium, lead, and selenium (n=163). Average THg concentrations were 365 ± 391 ppb (n=340). Significant variation in mercury detectable seasonal patterns in the mercury accumulation on lichens. We show that the association between mercury and lichens is stable over a one year period with minimal variability due to abiotic climate factors (solar radiation and temperature). The use of lichens as biomonitor of air quality is inexpensive and effective.

WE243 Biological monitoring of environmental quality near a solid waste incinerator in central Lithuania

G. Sujetočeviè, P. Smigalíèius, Vytautas Magnus University

We present the first study of airflow, wind field, and dust emissions from a hazardous waste incinerator located near the town of Utena in Lithuania. The incinerator was commissioned in 2014 and its emissions are controlled by European regulations. The aim of this study was to verify the effectiveness of the incinerator in reducing emissions and to determine the potential impact on the surrounding environment. A continuous monitoring system was installed at the incinerator site to measure the concentration of fine particulate matter (PM2.5) and other air pollutants. The results showed that the incinerator is operating within regulatory limits and has a low potential impact on the environment.

WE244 Nothing is what it seems: Levels of PCDD/Fs in the surroundings of a hazardous waste incinerator

M. Marques, Rovira i Virgili University / Chemical Engineering; M. Mari, Universitat Rovira i Virgili / Chemical Engineering; M. Nadal, Universitat Rovira i Virgili / School of Medicine, IISPV; M. Schuhmacher, Rovira i Virgili University / Department d Enginyeria Quimica; J.L. Domingo, Universitat Rovira i Virgili / Laboratory of Toxicology and Environmental Health

Soil and vegetation were used as environmental monitors to assess the occurrence of dibenzop-dioxins and polychlorinated dibenzo furans (PCDD/Fs) in the vicinity of a hazardous waste incinerator (HWI) located in Tarragona (Catalonia, Spain). Results belonging to 2015 and 2016 were compared to a previous study conducted in 1998, before the plant started operating, to evaluate the potential impact of the facility after several years of regular operation. The median concentrations of PCDD/Fs in soil samples collected around the HWI were 0.46 pg I-TEQ/g (dw) (range: 0.14 to 1.96 pg I-TEQ/g (dw)) and 0.44 pg I-TEQ/g (dw) (range: 0.13 to 1.34 pg I-TEQ/g (dw)) in 2015 and 2016, respectively. No statistical differences were found between 2015 and 2016 campaigns. Comparing the study of 1998 (median: 0.75 pg I-TEQ/g (dw)) with these carried out in 2015 and 2016, the concentration of PCDD/Fs statistically decreased by 41 and 55%, respectively. Median concentrations of PCDD/Fs in samples of vegetation collected in the vicinity of the incinerator were 0.32 pg I-TEQ/g (dw) (range: 0.11 to 0.68 pg I-TEQ/g (dw)) in 2015 and 0.17 pg I-TEQ/g (dw) (range: 0.09 to 0.36 pg I-TEQ/g (dw)) in 2016. The temporal trend of PCDD/Fs in vegetation was very similar to that of soil, with overall reductions of 4%, 30% and 27% over the period 1998-2015, 1998-2016, and 2015-2016, respectively, being statistically significant in the two latter periods. Although the concentrations of PCDD/Fs in both soil and vegetation samples collected in urban areas showed higher levels than those from rural areas, there was no direct relationship between the levels of PCDD/Fs and the direction or proximity to the plant. In addition, the comparison of PCDD/Fs profile of chimney emissions and the corresponding samples of soil and vegetation denotes noteworthy differences in the contribution of some congeners. Consequently, there is a low potential impact of the plant on the environment, regarding to the emission of PCDD/Fs. Finally, concentrations of PCDD/Fs in soils and vegetation here reported are similar and/or below those observed in the scientific literature for similar areas.

WE245 The use of land snail Cornu aspersum as sentinel organism to monitor air pollution

L. Sturba, M. Vannucchi, G. Liberati, F. Nannoni, G. Protano, University of Siena / Department of Physical, Earth and Environmental Sciences; N. Fattorini, University of Siena / Department of Life Sciences; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences

The use of biotest organisms for monitoring air pollution allow to assess real hazardous effects of airborne contamination over a geographical and temporal scale depending on selected species and scientific approach. The present study aimed to validate the use of the land snail Cornu aspersum as biotester of airborne pollutants effects by transplanting snails in plastic cages positioned in un urban area strongly impacted by several industrial activities nearby. Ten sites were selected based on wind field direction and distance from the main industrial area in order to assess pollutant distribution in terms of bioavailability and biological responses in a relatively short period of time. After four weeks trace metals levels in soft tissues of whole organism and several biochemical responses were investigated in different tissues and organs as: lysosomal membrane stability (LMS) and Micronuclei (MN) in hemocytes and antifibronectine enzymes Catalase (CAT) and Glutathione-S-transferase (GST), lipid peroxidation (MDA) and total Metalllothionein proteins content (MTs) in midgit. Results obtained by generalized linear mixed models (GLMMs) revealed significant correlations among trace metals levels and biological responses investigated and with the distance from
The relationship between lead exposure on dogs and their behavior around Pb mining area, Kabwe, Zambia

H. Tovomaki, Hokkaido University / Graduate School of Veterinary Medicine; J. Yabe, The University of Zambia / Veterinary Medicine, Paraclinical Studies; S.M. Nakayama, Hokkaido University / Graduate School of Veterinary Medicine; Y.B. Yohannes, Hokkaido University / Laboratory of Toxidology; K.M. Muzundu, University of Zambia; H. Tovomaki, Hokkaido University / Environmental Veterinary Sciences; Y. Ikenaka, Hokkaido University / Graduate School of Veterinary Medicine; H. Nakata, Hokkaido University; R. Dowling, J. Caravano, Pure Earth; M. Ishizuka, Hokkaido University / Graduate School of Veterinary Medicine

Lead (Pb) toxicity on both of human and animals has been known and caused neurological symptoms and even death in the worst cases. Our previous study has revealed Pb exposure on domestic dogs around a Pb mining area, Kabwe, Zambia. There was a trend that Blood Lead Levels (BLLs) in dogs in sites near to the mining area were higher than those in sites far from the mining area. Moreover, the difference of BLLs in the same area among individuals was found. This difference may be attributed to some factors, and behavior of dogs could be one of the important factors. The present study was undertaken to determine a relationship between Pb exposure on domestic dogs and their behavior recorded using GPS machines around the mining area in Kabwe, Zambia. Blood samples of domestic dogs which were freely roaming in the area were collected twice before putting GPS and after a week. BLLs were analyzed by LeadCare II. GPS devices were set to log every 1 minute and 30 seconds and attached to dog collars. In total, 53 male and 48 female domestic dogs were sampled. The overall mean of BLLs before and after a week were 2.42 μg/dL and 24.8 μg/dL, respectively. There was no significant difference between BLLs before and after a week. GPS log data was averaged collected for 4.4 days and the distances of dog movements per day was 17.6 km. There was no significant relationship between distances of dog movements per day and the gap of BLLs in dogs between before and after a week. The distance between the mining area and dogs’ home was significantly negatively correlated with BLLs (p < 0.05). The previous study revealed the concentrations of Pb in soils were negatively correlated with distance from the mine. These trends suggest that the distance from the mine is a key factor of Pb exposure on dogs. In the present study, there was a significantly negative correlation between BLLs and the gap of BLLs in dogs in dogs between before and after a week. In contrast to our hypothesis, there was no significant relationship between BLLs in dogs and their behavior. It suggested that mature dogs in the study area could be highly exposed to Pb regardless their behavior. An additional study focusing on the behavior of young dogs which are more vulnerable to Pb could get a different result of the relationship with their Pb exposure.

Cr transport in sweet peppers plants cultivated with vermicomposted tannery wastes

M. Rezende, Universidade de Sao Paulo / Chemistry; R.R. Rachide Nunes, Federal Rural University of Pernambuco / Chemistry; T. Oliveira, University of Sao Paulo / Chemistry; R.M. Bontempi, USP - Universidade de Sao Paulo / IQSC - Instituto de Química de Sao Carlos

Untreated waste water and solid waste generated by the tanning industry can cause serious environment damage, particularly to surface and groundwater. In order to avoid pollution, specific chemical, physical and biological treatments have been adopted to reduce waste toxicity, caused mainly by the presence of the chromium. Chromium exists in oxidation states of Cr (III) and Cr (VI). As it is well known, the trivalent oxidation state is the most stable form of chromium and it is essential to plants in trace concentrations. In other hand, the hexavalent is toxic and carcinogenic to mammals, even in small concentrations. Thus, the aim of this work was to investigate the Cr transport in sweet peppers cultivated with vermicomposts a method to reduce tannery waste. In order to investigate the Cr transport from the vermicomposts and its possible transportation through the plant, the content of Cr (III) and Cr (VI) were determined in the binary soil-plant: soil (at begging and post-harvest), roots, stalk, leaves, and mature fruits. Cr (III) and Cr (VI) were determined through graphite furnace atomic absorption spectroscopy (GF AAS). Values of Cr (VI) were below the detectable level (LOQ) in all the analysis. In general, all treatments showed a decrease on their Cr (III) content during the sweet pepper cultivation. The concentration of Cr (III) varied in leaves < stalks < roots < fruits. Values of chromium were in accordance with the maximum permitted in the Brazilian legislation for food security; Cr (VI) was not reported in any sample. A significant quantity of Cr (III) decreased between the concentration at the beginning and at final experiments (post-harvest). Assessing the dynamics of the Cr (III), root and shoots showed a high Cr uptake and the leaf showed a low Cr uptake. However, Cr (VI) showed a high content in all samples. Differences in the chromium contents were not observed between samples and treatments which received vermicomposted tannery wastes with others, without addition of chromium residues. Keywords: vermicomposting; tannery wastes; chromium; sweet pepper
disruption practice), and organic ones. Two frequently involved in pesticides resistance enzyme families: Glutathion–S-transferases (GST) and Carboxylesterases (CbEs) were studied, by measuring their activities on earwigs extracts. Acetylcholinesterase (AChE) activity, the molecular target of OP insecticides, was monitored as toxicological endpoint. We observed that the mortality rate of adult earwigs exposed to the authorized dose of chlorpyrifos depended on their genotypes. The lethal dose in non-mortal earwigs, AChE activity appears to be highly inhibited in earwigs from organic or IPM compared to conventional orchards. Moreover AChE inhibition increased when earwigs were exposed to both chlorpyrifos combined to a specific inhibitor of CBEs. Moreover, we observed that basal-activities of CBEs and GST of unexposed individuals are higher in conventional orchards compared to IPM and organic ones. All these observations support the hypothesis of a molecular target modification in AChE leading to a decrease of affinity with the insecticide, and highlight the role of CBEs ensuring effective protection of AChE. Our findings suggest the acquisition of resistance to chlorpyrifos in earwigs caught in conventional orchards and point out the necessity to understand these mechanisms in order to evaluate their relevance as biocontrol agents.

WE251

Bioaccumulation of persistent halogenated organic pollutants in insects:
Common alterations to the pollutant pattern for different insects during metamorphosis

L. Yu, Guangzhou Institute of Geochemistry / State Key Laboratory of Organic Geochemistry and Guangdong Key Laboratory of Environmental Resources Utilization and Protection; X. Luo, Guangzhou Institute of Geochemistry / State Key Lab. Organic Geochem; L. Tao, Guangzhou institute of Geochemistry Chinese Academy of Sciences; Y. Zeng, B. Mai, Guangzhou Institute of Geochemistry Ubiquitous use of halogenated organic pollutants (HOPs), such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and dichlorodiphenyltrichloroethanes (DDTs), can accumulate in organisms and become magnified along the food chain. Insects play an important role in the transformation of pollutants from abiotic to biotic media. However, few studies have been discussed the accumulation and fate of contaminants in insects. Furthermore, metamorphosis effects on the stable isotope signatures and enrichment characteristic of contaminants in insects, but the bioaccumulation pattern and mechanism during metamorphosis is not well understood. Therefore, we detected the concentrations of halogenated organic pollutants in four taxonomic insects (dragonfly, butterfly and moth, grasshopper, and litchi stinkbug), including three kinds of metamorphosis type, collected from an e-waste pollution region in South China. Stable isotopic analysis showed grasshopper have the highest δ15N value, indicating a C3-plant-based food source. In contrast, the butterfly, moth, and litchi stinkbug all represent a C4-based diet preference characterized by lower δ15N values. Moreover, enrichment of the heavy N isotope during metamorphosis is observed in the dragonfly and litchi stinkbug, but the other species (grasshopper, butterfly and moth) did not show significant increases in the values of δ15N from larvae to adults. Principal component analysis (PCA) was conducted using the fraction composition of HOPs were performed to evaluate the species-specific bioaccumulation. Different species of insects exhibited different contaminant patterns, which could be attributed to their habitats and feeding strategies. For example PBDEs were predominant in the dragonfly collected from the pond, which has been seriously contaminated by electronic waste; however, DDTs significantly contributed to the total HOPs in the butterfly and moth, and in the litchi stinkbug, and their host plants also have a high DDTs concentration. In addition, in common multi-linear correlations between In adult/larva and log Kow of the compound was observed for the four taxonomic insects. The ratio of larva to adult decreased with increasing values of log Kow (log Kow < 6.5), then increased (6 < log Kow < 8) and decreased again (log Kow < 8). The results of this study demonstrated that a common mechanism is responsible for the fate of HOPs during metamorphosis in those insects.

WE252

Glyphosate: toxic or not toxic, this is the question.

M. Verderame, R. Scudiero, University Federico II / Department of Biology Insect pest management: biological vs chemical biocontrol agents (GBH), a broad spectrum herbicide widely used in agricultural, industrial and urban areas, is a great matter of debate. Although classified by the EPA as “non-toxic and not an irritant” and by the EFSA as “no carcinogenic to humans”, converging evidence suggests that GBHs, such as Roundup (Monsanto), pose serious health risk on non-target wildlife. Many studies demonstrate that GBHs threaten the reproduction environmental pollution. Adult P. sicula specimens were divided in 3 groups (n=6); group 1 and 2 were exposed to pure Gly 0.1 and 1 µg/L respectively, via gavage every other day for 3 weeks; group 3 received by gavage the same dose of tap water (100µl). The results demonstrate that both Gly doses are toxic for the liver that shows an increase of melanocytes degranulation and the appearance of nodular/cystic formations mainly consisting of collagen fibers, typical of hepatic fibrosis. The liver of Gly-treated males also displays the biosynthetic alterations typical of an estrogenic contamination: hepatocytes, in fact, contain transcripts for both vitellogenin and estrogen receptors. At reproductive level, male gonad is affected by the treatment. Spermatogenesis is slightly slower, at low dose of Gly scattered spermatocytes II lute, forming a filament-like arrangement, at high dose the abundance of rosettes increased. Spermatids and spermatozoa are intact. Alterations are evident in the lumen of the tubules. Alterations in the expression of estrogen and androgen receptors and aromatase are also detected. Interestingly, in females, the ovary is not affected by Gly exposure, no matter the dose. Our results suggest that Gly exposure in a terrestrial vertebrate commonly inhabiting the fields potentially exposed to GBHs causes tissue toxicity, with possible serious health implications for wild and breeding animals as well as human populations.

WE253

Concentration of perfluoroalkyl substances decreases according to the laying order in the yolk of yellow-legged gull eggs

C. Bassi, M. Vedolin, University of S. Paolo; M. Mazzoni, University of Insubria, DISTA / Water Research Institute; B. De Felice, Università degli Studi di Milano; F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNR; S. Polese, Water Research Institute- CNR / Water Research Institute; N. Saino, University of Milano; M. Parolini, University of Milan / Department of Environmental Science and Policy; S. Valsecchi, Water Research Institute Italian National Research Council IRSA-CNR; M. Petti, University of S. Paolo / Instituto Oceanografico; M. Petti, University of São Paulo / Instituto Oceanográfico; R.C. Figueira, University of São Paulo / USP / Institute of Oceanography; S. Valsecchi, Water Research Institute

Perfluoroalkyl substances (PFAS) are chemicals used as surface-active agents in diverse industrial applications. Because of their incessant disposal and release to the environment, these molecules caused the contamination of both fresh and seawaters, entailing their accumulation in the biota. Seabirds are highly exposed to environmental contamination because of their ecological habits, high trophic position in the marine food-chain and large laying period. Perfluoroalkyl substances (PFOA) and perfluorododecanoic acid (PFDoDa), a common pair of contaminants, are detected at high concentrations in bird eggs and the variation of their concentration according to the laying order is still inadequate. Thus, the aim of the present study was to determine the levels of PFOA and PFDoDa in three-egg clutches of the yellow-legged gull (Larus michahellis) breeding in a colony located at the Comacchio lagoon (Northern Italy) and their variation according to the position in the laying sequence. Eleven perfluoroalkyl acids (PFAA) were analyzed in the yolk of eggs sampled at the time of deposition from 15 three-egg clutches. Independently of the laying order, perfluorooctane sulfonate (PFOS) was the main compound detected in the egg yolk, followed by perfluorooctanoic acid (PFOA) and perfluorododecanoic acid (PFDoDa). Overall, the ΣPFAA decreased according to the position in the laying sequence, with first- and second-laid eggs showing higher concentrations compared to last-laid eggs. A similar decreasing trend was also noticed for single compounds, namely PFOA, perfluorononanoic acid (PFNA), perfluorooctanoic acid (PFOA), perfluorobutanoic acid (PFBA) and PFDoDa, with concentrations measured in the last-laid eggs that were significantly lower compared to those from the first- and second-laid eggs.

WE254

First assessment of metal concentration in the crab Goniopsis cruentata (Linnaeus, 1758) (Decapoda, Grapsidae) from two brazilian mangroves areas with different levels of contamination

M. Vedolin, University of São Paulo USP; T.H. Trevizani, Universidade de Sao Paulo / Instituto Oceanográfico; M. Petti, University of São Paulo USP; R.C. Figueira, University of São Paulo USP / Instituto of Oceanography

The crab Goniopsis cruentata is a common semi-terrestrial species in Brazilian mangroves. Its geographical range includes the eastern Atlantic Ocean from Bermuda to Brazil, and the eastern Atlantic Ocean from Senegal to Angola. The species is an important fishery resource for traditional communities in the same regions of Brazil. These ecosystems are located in regions of intense anthropic activity and have been proved to accumulate heavy metals. The use of wetlands is of fundamental importance because it allows to outline comparisons over space and time and provides significant ecological integrated measures of the selected metals within the studied system. This study aimed to assess the levels of metals (As, Cd, Cu, Cr, Ni, Pb and Zn) in different tissues (muscle, hepatopancreas and gills) of G. cruentata and compare populations from contaminated and non-contaminated areas. Samples were collected in two mangrove areas in São Paulo State during different levels of contamination during a period of one year, to assess the bioaccumulation of metals associated with seasonality. A two-way ANOVA was carried to analyze interactions between season and sites. The results showed high concentrations of metals in the gills, which was considered a strong reflection of high exposure of G. cruentata to these contaminants. In general, the hierarchical pattern of metals concentration in organs was represented by gills>hepatopancreas> muscle, except for Zn. There were significant differences in metal levels between seasons and sites (p<0.05). The highest concentrations were observed in the summer, which corresponds to the period of greatest metabolic activity of the organisms. Surprisingly, organisms from...
unpolluted regions, accumulated more metals than from polluted areas. Thus, we concluded that there are external factors (e.g., pH, salinity) that reduce the mobilization of these chemicals to the organisms and, consequently, their bioavailability to the local biota. Therefore, studies of metal concentrations in mangrove areas are relevant and useful for monitoring the health of environment, maintenance of biodiversity, and for assuring the quality of life, mainly for human consumption.

WE255 Maternal Transfer of persistent halogenated organic pollutants in Watersnakes (Enhydris chinensis) X. Luo, Guangzhou Institute of Geochemistry / State Key Lab. Organic Geochem.; L.W. Guangzhou Institute of Geochemistry, Chinese Academy of Sciences / State Key Laboratory of Organic Geochemistry; B. Mai, Guangzhou Institute of Geochemistry

Halogenated organic pollutants (HOPs) such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and dichlorodiphenyldichloroethanes (DDTs) are ubiquitous contaminants in the environment. Maternal transfer of HOPs to the offspring, along with the different chemical substance groups from Dechloran Plus and other dechloranes to brominated benzenes and alkyl benzenes, ethers and esters (TBA, WE256)

Development of a Multi-compound Multi-matrix Method for Analysis of Halogenated Flame Retardants Comprising a Multi-step Cleanup and Use of GC-API-MS/MS and GC-EI-MS F. Neugebaeuer, Eurofins GFA Lab Service GmbH / R&D; A. Dreyer, Eurofins GFA GmbH N. Lohmann, Eurofins GFA Lab Service GmbH; J. Koschorreck, Umweltbundesamt

The ultra trace analysis of halogenated flame retardants (HFR) is used as an indicator and the differences in the maternal transfer mechanism.

WE256 Development of a Multi-compound Multi-matrix Method for Analysis of Halogenated Flame Retardants Comprising a Multi-step Cleanup and Use of GC-API-MS/MS and GC-EI-MS F. Neugebaeuer, Eurofins GFA Lab Service GmbH / R&D; A. Dreyer, Eurofins GFA GmbH N. Lohmann, Eurofins GFA Lab Service GmbH; J. Koschorreck, Umweltbundesamt

The ultra trace analysis of halogenated flame retardants (HFR) is used as an indicator and the differences in the maternal transfer mechanism.

product benefits and positive outcomes: valuation and beyond (P)
Life Cycle Air Emissions External Costs Assessment for comparing Electric and traditional passenger cars

P. Girardi, P.C. Brambilla, RSE Spa / SFÉ

The scope of this study is to compare the externalities of electric, gasoline and diesel motorisations of an average passenger car (a/Wolf) giving a complementary reading of the results of an LCA. Starting from the results of the NEEDS project, authors present a methodology taking into account: the year of the production, the composition of the supply chain of the vehicle, its size, the emissions of each stage (electric) and the height of the release; the population density of the area where the emission take place; the average level of income of the country in which the emission take place. A complete LCA of an electric, gasoline and petrol VW Golf has been carried out considering city cycle real consumptions from EPA (fueleconomy.gov) and real emissions from national inventories. The use phase (http://www.sinanet.ispambiente.it/it/ia-ispra/etrantso). The use phase of the vehicles occurs in Italy, the energy used for battery charging is the Italian marginal mix, the vehicles assembly occurs in Germany while batteries are assembled in Austria. The upstream of fossil fuel is consistent with the nowadays actual national import mix. Emissions of PMx, PM2.5, NOx, SOx, NH3, NMVOC, CO2x have been taken into account for externalities evaluations. Considering that the electric vehicles perform better in terms of external costs, mainly thanks to the smaller costs due to Climate Change. As regard regional externalities, the external costs due to emissions in Italy make the electric vehicle even more competitive than considering the overall regional externalities.

WE263 Life Cycle Costing: methodological description and implementation

B. De Caevel, J. Dulbecco, RDC Environment; A. Ciroth, GreenDelta; T. Hupertz, I. Descos, RDC Environment; J. Garcia, SCORE LCA

The complexity of production processes and products combined with an increasing demand of externalities valuation has created the request to monitor and analyze not only the production phase, but also all upstream and downstream costs. Thus, producers are seeking to minimize the overall cost of their product generated throughout the life cycle. The private consumer, on the other hand, seeks to compare the different investment or purchase options by trying to integrate, in a holistic way, their present costs (acquisition prices and associated taxes) and future costs (use upstream of fossil fuels). Life Cycle Costing (LCC) is the typical tool to meet these objectives as it allows to analyze the cost structure of a specific object throughout its life cycle. Due to their convergent approach over life cycle, there are some complementarities between LCC and Life Cycle Assessment (LCA). A combined application of the two approaches could help economic actors and decision makers to find cost-effective solutions, while minimizing their environmental impacts. The environment has created the request to monetize the environmental impacts, to be able to aggregate them with the economic costs. Responding to SCORE LCA’s enquiring about LCC and its complementarity with LCA, the purpose of this study is to make the tools to key understanding LCC, its concepts, its scope of use and its theoretical and conceptual limits. It also presents operational implementation elements such as: current methods of applying the LCC, means available for its implementation and possibilities of coupling it with LCA. In a first part, we present the theoretical bases and the state of LCC practice, i.e. definition and history, usefulness and reasons why the method is still not widely used. The second part presents the different types of LCC and the cost parameters considered for each of them. The third part presents how to implement LCC, with detailed recommendations. The fourth part is dedicated to the possibilities of coupling LCC and LCA in practice by first showing the usefulness of such a combination, then by presenting the software that allows coupling methods. We conclude by identifying the necessary work to improve the practice of LCC and LCA coupled with LCA.

WE264 Pizza: it is dangerously delicious!

K. Stylianou, University of Michigan - School of Public Health / Environmental Health Sciences; V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; V. Lun, Fulgoni III, Nutrition Impact, LLC; O. Jollivet, University of Michigan

The saying, we are what we eat, is true! Diets are key for human health, more than 10 million deaths/year worldwide are attributable to dietary risk factors. The saying, we are what we eat, is true! Diets are key for human health, more than 10 million deaths/year worldwide are attributable to dietary risk factors. The saying, we are what we eat, is true! Diets are key for human health, more than 10 million deaths/year worldwide are attributable to dietary risk factors.
primarily focuses on single ingredient items while a large portion of modern diets is comprised of mixed dishes, a mixture of ingredients, which often remains unexplored. We propose a framework for evaluating mixed dishes in LCA that considers nutritional health impacts and benefits and demonstrate its application on pizza. We develop 14 marginal nutritional characterization factors (CFs) that cover major food groups and nutrients and allow the assessment of nutritional health effects in LCA. CFs are estimated by coupling age- and gender-adjusted outcome-specific incidence rates with risk ratios and severity factors from the Global Burden of Disease, measuring benefits (+) and impacts (-) in avoided μDALY/g. To evaluate the environmental impacts, we deconstruct pizza into “basic ingredients” using the USDA Standard Reference 28 database with a resolution of 3,200 single- and multi-ingredients that we further deconstruct. Ingredients are then linked to life cycle inventory (LCI) datasets from the EcoInvent v3.2, the World Food LCA Database v3.1, and the ESU World food database. We evaluate impacts using Impact World+. Nutritional CFs for food group and nutrient range between -8 (sodium) and 57 (omega-3 from seafood) avoided μDALY/g. Human health scores for pizzas range from -35 avoided μDALY/serving pizza with extra meat to 2 avoided μDALY/serving pizza with no cheese. For the environmental impact assessment, global warming estimates vary from 0.06 (pizza with no cheese) to 0.20 (pizza with extra meat) kg CO2 eq/serving, corresponding to -0.04 and -0.17 avoided μDALY/serving, respectively. When it comes to pizza, environmental emissions further enhance nutritional health impacts. Nutrition can dominate the human health and should be considered in food LCA. We have developed an approach bringing together environmental and nutritional health effects in a common metric that most precise FU is to compare protein sources based on performance of all food items and diets in LCA. Expanding this approach to various foods could help decision-makers and consumers not only make better comparisons but also identify sustainable food items and adopt sustainable diets.

**WE265**

The impact of supplemented amino acids in animal feed - a new Life Cycle Assessment approach using the Protein Quality Index as functional unit for comparing protein sources

A. Wojciechowski, Evonik Technology & Infrastructure; M. Binder, Evonik Nutrition & Care GmbH

Proteins, which are made up of amino acids (AA), are essential for human health. Most of AA can be synthesized by the body but 8 of them are called “Essential Amino Acids” (EAA) because they cannot be produced by human or animal and it is crucial to get them through food or feed intake. AA are also used as supplements in animal feed, providing the option to reduce the protein content of feed. Protein production has a major impact on the environment: it is responsible of ~14.5% of all human induced greenhouse gas emissions but also requires large amount of land and water due to the high quantity of crops required for feeding animal. Consequently, comparing protein sources using Life cycle assessment (LCA) is important for decision-making. However, choosing the functional unit (FU) is often a critical issue for food systems. The quantity of food (i.e. 1 kg) is the most used FU currently. Nevertheless, this FU does not represent the function of food that is to provide proteins. A more precise FU is to compare protein sources based on their protein content (i.e. 1 kg protein). To have a more holistic approach, nutritional and qualitative aspects should also be included in the FU. Actually, most plant protein sources do not bring all the EAA required. In this study, the Protein Quality Index (PQI) developed by Sonesson (Sonesson et al., 2016) was applied as a FU. It takes into account aspects such as EAA, AA digestibility, AA requirements but also food quality. In our study, PQI was conducted on several proteins coming from conventional (pork, chicken meat, salmon and tofu) and non-conventional sources (insects and algae). The role of the AA supplementation in animal feed was also investigated. On the one side, the analysis has shown that non-conventional protein sources perform better in all environmental categories, independently of the choice of the functional unit. Tofu performs better than animal protein but the difference between animal and vegetable based proteins becomes much lower when a more elaborated FU is used. On the other side, the supplementation in AA allows a reduction of the environmental impact of chicken and pork. Using the PQI as a FU, the impact of chicken and pork with AA supplementation is even lower than the one of tofu in some categories. Using the PQI as a FU is a step toward a more holistic assessment. A next step might be to include other nutrients of tofu in some categories. Using the PQI as a FU is a step toward a more holistic approach bringing together environmental and nutritional health effects in a common metric that most precise FU is to compare protein sources based on performance of all food items and diets in LCA. Expanding this approach to various foods could help decision-makers and consumers not only make better comparisons but also identify sustainable food items and adopt sustainable diets.
Salt of the earth - causes, consequences and management of salinization of surface freshwaters, groundwaters and soils (P)

WE269
Effects of long-term exposure to increased salinity in the amphibian skin bacterium Erwinia toletana
A.C. Gabriel, University of Aveiro / Biology; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; S. Costa, Universidade de Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; I. Henriques, Universidade de Aveiro / Departamento de Biologia CESAM

Amphibians constitute the class of vertebrates with the highest proportion of endangered species. Chemical contamination being a main factor for its populations and species decline. The skin bacterial community of amphibians may help them to cope with such chemical contamination. If skin bacteria may increase its tolerance to chemicals, then they could be used for bioaugmentation in amphibians to help them cope with contamination. This work aimed to assess if an amphibian skin bacterium could increase its tolerance to NaCl after long-term exposure to low levels of salinity. Erwinia toletana, isolated from the skin of Pelophylax perezi, was selected as the model species. Clonal populations of this bacterium (5 replicates) were exposed for 46 days to LB medium (Et-LB) or to the effective concentration of NaCl causing 10% of growth inhibition (Et-NaCl; 18 g/L). To assess the capacity of recovery from long-term exposure to NaCl, after the 46 d period, Et-NaCl was transferred to LB medium and cultured for a period of 16 d (Et-R). The isolate also continued to be cultured in LB medium for further 16 d. The tolerance of ancestral and evolved populations to NaCl was assessed by exposing them to 6 NaCl concentrations (5, 10, 15, 20, 25 and 35 g/L) plus a control (LB medium). Effects of NaCl on bacteria growth and metabolic mechanisms (as degradation of carbon compounds) was monitored. Genotypic alterations were assessed using a PCR based molecular typing method (BOX-PCR). Results of growth showed that long-term exposure to NaCl slightly increased the tolerance of E. toletana to this salt, EC50 for growth were: 22.5 g/L (8.64-36.4) for Et-LB; 30.5 g/L (23.2-37.4) for Et-NaCl, and 26.1 g/L (19.3-32.9) for Et-R. Though, as confidence limits overlapped, tolerance increase was not considered significant. Furthermore, differences in metabolic processes were observed between Et-LB and Et-NaCl, suggesting the use of different carbon sources. This could be associated with the activation of detoxification mechanisms or energetic demanding mechanisms to cope with osmotic stress. Genotypic alterations were not observed, indicating that E. toletana increased tolerance to NaCl could be due to membrane plasticity mechanisms to cope with osmotic stress. The tendency shown by E. toletana to acquire increased tolerance to low levels of salinity could constitute a promising bioaugmentation tool in amphibian’s skin, aiming the improvement of these organisms tolerance to chemicals.

WE270
Effects of salinity on stream macroinvertebrate communities?
B. J. Keeford, J. Reich, J. Bray, University of Canberra / Institute for Applied Ecology

The effective chemicals on populations and communities have long been noted to vary between different studies although the mechanism(s) for this variation is unclear. Research has examined variability associated with chemical and physical environments (e.g. bioavailability, co-occurring contaminants) and ecotoxicological and physiological (e.g. temporal and spatial variability in species’ sensitivity). Less consideration has been given to ecological mechanisms including those via indirect effects such as competition and predation. For example, a given population of a species may be able to persist in the presence of a particular level of contamination, but this persistence may be dependent on competition and predator prey interactions, and the relative fitness of these taxa at that level of contamination. Here we report the results of a mesocosm experiment that examined the effects of biotic interactions on salinity effects. We examined effects across a broad salinity gradient using ‘sensitive’ communities collected from a low salinity site (~80 μS/cm) and ‘tolerant’ communities (collected from a high salinity site ~1600 μS/cm). This was examined using a mesocosm experiment consisting of 32 independent re-circulating 1000 L mesocosms. Controls (100 μS/cm) and salinity treatments (500, 1000, 2500 and 5000 μS/cm) these were replicated 4 fold and were crossed in an orthogonal design with the source biota (stream macroinvertebrates and microbes) either from: (1) a low salinity site only or (2) both low and high salinity sites. The experiment is based on the logic that if salinity increases at a site, organisms have the potential to migrate from higher salinity sites within the same region. Thus the organisms from the (previously) low salinity site would have to be able to tolerate both the increase in salinity and ecological interactions with organisms from higher salinity sites. We observed differing effects of salinity on the macroinvertebrate community from the low salinity site depending whether these biota were co-inhabiting with biota from a high salinity site. Such context dependent toxicity deserves greater consideration in studies of the effects of chemicals on populations and communities.

WE271
Challenges in developing a water quality guideline for water hardness
S. Bogart, University of Lethbridge / Department of Biological Sciences; E. Stock, University of Lethbridge; A. Manek, University of Saskatchewan; A. Tillmanns, C. Meays, British Columbia Ministry of Environment & Climate Change Strategy; G.G. Pyle, University of Lethbridge / Biological Sciences

Saltine soil can be an advantage but an impact. I. Al-Husayni-Roggenbuck, Superficie Agroinquinamiento. Universidad Politécnica de Cartagena / Cartagena y Tecnología Agraria; F. Jiménez-Cárceles, BIOCYMA, Consulting in Environment and Quality, S.L. Murcia, Spain.; M. González-Alcaraz, Department of Biology & CESAM - University of Aveiro / Biology & CESAM

Increasing salinity is one of the most critical factors of soil and water degradation worldwide. Anthropogenic salinization due to the use of low quality water and over-fertilization leads the existence of saline effluents that degrade water quality and constrain plant growth and crop production. However, in saline wetlands salinity is not undesirable, but a proxy parameter to maintain the singularity of the ecosystem. In these environments the existence of a diversity of habitats is closely related to gradients of soil salinity and moisture, with extremely saline sites, brackish sites, wetter sites and drier sites. While agricultural saline effluents may saltinize normal soils, they can degrade saline wetlands by decreasing the native soil salinity. This report works changes in ecosystem structure and diversity in a saline wetland adjacent to the Mar Menor saline lagoon (SE Spain). Species cover, soil salinity, and the groundwater level were monitored in two 2-years periods with a difference of 13 years between them. The results indicated an elevation of the water table throughout the 13-year period, which was attributable to brackish water flowing from areas with intensive agriculture. This latter led to an increase of flooding periods, a decrease of soil salinity in the macrophytic sites and an increase in the least saline ones. Following these changes, damages in protected habitats were observed, due to the proliferation and increase of biomass of several species. Sarcocornia fruticosa, Phragmites australis and Juncus maritimus strongly expanded at the wettest sites, which led to the disappearance of the original zonation pattern and the homogenization of the ecosystem. Bare areas, necessary for nesting and feeding of several bird species, disappeared. According to the results obtained, a decrease of soil and water salinity was one of the main factors contributing to the degradation of the saline wetland leading to an exacerbated growth of some species and a decrease of habitat diversity. In this case, the low salinity of the effluents reaching the wetland was a problem, not an advantage.
WE273
Prioritization of water quality stressors according to their relative impact on ecological quality of rivers using large-scale field data: salinity first? 
E. Berger, Senckenberg Gesellschaft / Department Quantitative Landscape Ecology; R. Schäfer, University Koblenz-Landau; P. Haase, A. Sundermann, Senckenberg

The political aim of achieving good ecological quality of all European water bodies requires knowledge on how to prioritize stressors and human pressures for management based on their relative impact. A challenge thereby is the frequent co-occurrence of multiple stressors. We applied eco-epidemiological approaches to large scale monitoring data from Saxony, Germany, to investigate the relative contribution of different water quality and land-use gradients to ecological change. Two approaches were applied: First, water quality gradients (e.g. oxygen, conductivity, phosphorus and micropollutants) and land-use gradients (e.g. % arable and urban catchment land cover, position of wastewater treatment plants) were used as predictor variables in multiple linear regression analysis and hierarchically partitioning with ecological quality indices based on invertebrates (% EPT, MMI, ASPT, BMWP, GIS, SPEAR %) as response variables. Secondly, individual taxon responses with respect to different water quality gradients (including also major ions such as potassium, sodium, chloride etc.) were assessed using Threshold Taxa Indicator Analysis (TITAN). The method is based on change point and indicator species analysis and allows the identification of ecological change points that may be used to derive environmental quality criteria. Both regression analysis and TITAN results indicate a high impact of oxygen and salinity, which were assessed as both important human pressures and to achieve good ecological status according to the water framework directive. Thu

WE274
Estimating protective potassium concentrations for freshwater mussels, a taxon of global conservation concern 
T. Augspurger, U.S. Fish and Wildlife Service / Ecological Services

Currently, there are about 620 species of freshwater mussels (Family Unionidae), and IUCN lists 28 species as extinct and 106 as endangered or critically endangered. Mussels are among the most sensitive freshwater organisms to toxicity from chloride and potassium, and the environmental relevance of these is increasing with sea level rise and brine discharges. Average potassium concentrations in relatively unpolluted streams of North Carolina (USA) range from 0.2 to 2 mg/L. An industrial effluent with potassium averaging 504 mg/L and proposed for discharge to a stream with a potassium concentration of 4.5 mg/L necessitated derivation of an environmental potassium standard. Other factors influencing mussel toxicity concentrations were identified, including salinity and temperature. Although observed associations may not be direct causes of ecological impairment, they may be worthwhile to implement legally binding quality standards for these variables. Of the 324 analyzed taxa 23% had change points far below the German water quality guideline of 7 mg/L potassium was recommended as an instantaneous acceptable test water quality. Five EC50s ranged from 31 to 48 mg/L at a water quality criteria for potassium). From the literature, we compiled potassium 96 end points of lethality or immobilization) for mussels and retained those with > 90% control survival, measured test chemical concentrations, and acceptable test water quality. Five EC50s ranged from 31 to 48 mg/L at a water hardness of 100 mg/L as CaCO3, and we applied the North Carolina guidance of 200 mg/L as CaCO3 to define an acute toxicity level. We adjusted the 10 mg/L acute limit to a water hardness of 18 mg/L which is the 5th percentile of the proposed receiving stream (potentially most of the time because potassium is less toxic as hardness increases). The hardness-adjusted acute water quality guideline of 7 mg/L potassium was recommended as an instantaneous standard not to be exceeded. Chronic toxicity data for potassium and mussels were available for two studies from 28 to 300-d. Because mussels can live for decades, we used the 300-d test. The geometric mean of the test NOEC (1 mg/L) and LOEC (7 mg/L) yielded a chronic value of 2.6 mg/L potassium which was recommended as a monthly average guideline not to be exceeded more than once every three years. We used 32 years of receiving stream flow data to derive ecosystem of instream mussels and predict potential impacts. We identified many uncertainties in guideline derivation and discuss recommendations for quarterly mussel toxicity tests, instream monitoring, and research to narrow uncertainties. There are several means by which stream-specific and mussel-specific potassium guidelines could be derived. This method tracks North Carolina water quality standards and definitions and is reasonable with available data.

WE275
LIFE LAGOON REFRESH - Coastal lagoon habitat (1150*) and species recovery by restoring the salt gradient increasing fresh water input. Management measures in the northern Venice Lagoon (NE, Italy) 
P. Cacciatore, ISPRA-Institute for Environmental Protection and Research / Mitigation and Prevention of Impacts; A. Bonometto, A. Feola, E. Ponis, ISPRA Institute for Environmental Protection and Research; A. Stùfro, University Ca Foscari of Venice; B. Matticchio, IPROS; M. Lizer, Regione del Veneto; V. Volpe, Provveditorato OO. PP. Veneto, Trentino Alto Adige e Friuli Venezia Giulia; M. Ferla, R. Boscolo Brusà, ISPRA - Institute for Environmental Protection and Research

The northern Venice Lagoon (SCI IT3250031) holds several Annex I-listed habitats of the Habitats Directive, such as the habitat type 1150* (Coastal lagoons). Recent monitoring activities showed that conservation status of the habitat 1150* is improving within SCI IT3250031, but it is still unfavourable in the inner and intermediate lagoon areas due to lack of ecosystem services, favouring self-regulation processes, between lagoon and mainland. In the past, the project area was occupied by reedbeds in large amounts, now significantly reduced due to increasing of lagoon water salinity, caused by historical human activities (e.g. diversion of rivers with reduction of freshwater supply, inlet and channel excavation). With reduction or disappearance of reedbeds, their contribution to ecosystem services, like supporting numerous biological communities and species, are minimised. The LIFE LAGOON REFRESH project, started on Sept 2017, foresees the restoration of favourable conservation status of habitat 1150* in the northern Venice Lagoon and the creation of suitable habitat for faunal species of community interest. The project actions involve: diversion of a freshwater flow from the site river into the lagoon (necessary for the recreation of the typical salt gradient of buffer areas between lagoon and mainland); restoration of intertidal morphology through the implementation of structures properly arranged to slow down the freshwater dispersion and to favour reed development; planting of Phragmites australis to accelerate the development of the reedbeds; transplantation of small dumps of seagrass species of the habitat 1150*, suitable to accelerate the recolonization by aquatic plants of low-salinity environments. The project aims to exploit the serially diluted effluents and synthetic solutions (e.g. NaCl, CaCl2, MgCl2) of system and sodium. There were different growth responses to the wastewater and saline solution among both plant species. F. rubra was cultivated at a significantly higher survival percentage than T. pratense. After four weeks of exposure, T. pratense exhibited higher sensitivity and salinity tolerance. F. rubra grew under salts stress, and presented a mechanism to cytolestatic salt on their leaves. Hence, plant uptake, under certain conditions, may be promoted as an alternative treatment for high salt concentrations.

WE276
Comparing the growth of fescue and clover plants in petroleum industrial effluents and solutions of similar salinity 
P. Srikhumsuk, University of Strathclyde / Department of Civil & Environmental Engineering; C. Knapp, J. Renshaw, University of Strathclyde / Civil and Environmental Engineering

Effluents (produced and flow-backs) from petroleum industry have been between land and mainland); restoration of intertidal morphology through the implementation of structures properly arranged to slow down the freshwater dispersion and to favour reed development; planting of Phragmites australis to accelerate the development of the reedbeds; transplantation of small dumps of seagrass species of the habitat 1150*, suitable to accelerate the recolonization by aquatic plants of low-salinity environments. The project aims to exploit the serially diluted effluents and synthetic solutions (e.g. NaCl, CaCl2, MgCl2) of system and sodium. There were different growth responses to the wastewater and saline solution among both plant species. F. rubra was cultivated at a significantly higher survival percentage than T. pratense. After four weeks of exposure, T. pratense exhibited higher sensitivity and salinity tolerance. F. rubra grew under salts stress, and presented a mechanism to cytolestatic salt on their leaves. Hence, plant uptake, under certain conditions, may be promoted as an alternative treatment for high salt concentrations.

WE277
Contribution to the salinization risk assessment, under drought conditions, in the Alqueva irrigation area (South Portugal) 

In Mediterranean regions, climate changes have enlarged water limitation for crops, leading to an increased demand for irrigation water. During the hydrological years of 2017/2018 and 2018/2019, drought conditions were observed throughout almost the entire mainland territory reaching a severe drought level. Under water scarcity conditions and high atmosphere evaporative demand, the risk of land salinization is one of the major threats to the sustainability of irrigated agriculture. Therefore, it is very important to assess the quality of irrigation water and the risks of salinity for crop production, in order to adopt appropriate management practices in irrigated areas. This study is focused on the salinity risks for the production of the most representative crops grown in the Alqueva irrigation area. This is a large irrigation scheme with a total area of 120 000 ha centered in the Alqueva reservoir. For the purpose of the study, a chemical assessment of some
major inorganic ions (Na⁺, Ca²⁺, Mg²⁺, K⁺, SO₄²⁻ and Cl⁻), pH and electric conductivity (ECₑ), was conducted throughout 2017, on water samples collected on four platforms sited in the reservoir. Water quality for irrigation was evaluated considering both the Portuguese regulations and the FAO guidelines. Sodium adsorption ratio (SAR) and soil salinity (ECₑ) were estimated, in order to assess potential sodium-related soil permeability and crust formation stress, as well as, potential yield reductions in the most significant crops of the Alqueva perimeter. Higher ion concentrations in the water salinity and pH were selected when determining the potential evaporation demand. Sodium hazard assessment showed slight to moderate risk of reduced infiltration rates, a result that should be taken into account when surface or sprinkler irrigation systems are used. Furthermore, relative yield reductions may be mainly found in horticultural crops, classified as moderately sensitive to sensitive in the salt tolerance scale.

**Systems ecotoxicology: application of OMICS data across multiple levels of biological organization in research and risk assessment (P)**

**WE279**

Investigating wildlife diets using high-tech DNA sequencing

J. Ludwigs, Rifcon GmbH; I. Katzschner, Rifcon GmbH Goldbeckstr Hirscheng Germany; G. Weyman, ADAMA; A. Winkler, J. Kalinowski, Center for Biotechnology (CeBiTec Universität Bielefeld

In wildlife risk assessments according to EFSAs (2009), the ingested diet is one of the core factors to define exposure, using different diet composition in the first tier risk assessments. The so-called PD factor (composition and/or portions of diet) is based on the standard refinement parameters which intends to add realism to higher tier risk assessments. Publicly available dietary data are often used to refine PD in wildlife risk assessments; however, such data are often variable and/or not representative for the specific risk assessment scenario. Besides such literature data, specifically registration-relevant PD field studies can be conducted. PD values gathered from such studies are based on codalays factors, study for their inclusion in test toxicity tests. In these studies, samples (or parts thereof), are investigated visually by microscope and food items are identified based on comparison with comprehensive reference data libraries and collections of potential diet items. For plant material, the results are mainly presented on a fairly basic taxonomic level and are often related to wildlife risk assessment defined diet fractions which have different results depending on whether plants or monocots are involved. In this case, this is rather time-consuming and imprecise. Recently, DNA sequencing techniques are increasingly applied for diet composition analyses in ecological science. We initiated an approach using ‘next-generation’ DNA amplicon sequencing to quantitatively assess the diet composition of wild herbivorous mammals, taken from faeces samples collected on arable fields. Data on the relative abundance of each plant species were derived by enrichment and sequencing of a specific DNA region (ITS2 region of the ribosomal DNA) and by comparison to comprehensive plant species DNA databases. The approach has proved to be very useful on identification of relative abundances of plant species from faecal samples. This new genomics approach, its needs and limitations for refined risk assessment will be presented and discussed.

**WE280**

Design of a Real-Time PCR array to analyze the gene expression in Physella acuta (Gastropoda) in chemical stress and starvation

M. Novo, J. Martínez-Guitarte, UNED / Fisica Matematica y de Fluidos Molecular endpoints are nowadays under study for their inclusion in test toxicity tests. While vertebrate species are usually well-known; there is a lack of information on invertebrates. The study of the latter is complex since their body shape, behavior, and ecology are very diverse, and great differences can be found even within the same animal group. In order to improve our knowledge in putative molecular endpoints and to evaluate some genes as biomarkers, a Real-Time PCR array has been designed for Physella acuta. This species of freshwater snail is used in environmental toxicology studies and it has been proposed as an adequate species for toxicity tests because of its sensitivity to different toxicants and ease of culture. A transcriptome for this species was assembled, by sequencing cDNA libraries from individuals of different developmental stages and exposed to different toxicants. Comparison with database allowed the identification of genes involved in pathways related to toxicity (i.e. deoxycytidolins plants or mononucleotidolins plants only). However, this is rather time-consuming and imprecise. Recently, DNA sequencing techniques are increasingly applied for diet composition analyses in ecological science. We initiated an approach using ‘next-generation’ DNA amplicon sequencing to quantitatively assess the diet composition of wild herbivorous mammals, taken from faeces samples collected on arable fields. Data on the relative abundance of each plant species were derived by enrichment and sequencing of a specific DNA region (ITS2 region of the ribosomal DNA) and by comparison to comprehensive plant species DNA databases. The approach has proved to be very useful on identification of relative abundances of plant species from faecal samples. This new genomics approach, its needs and limitations for refined risk assessment will be presented and discussed.

**WE281**

Validating a contamination assessment tool from lab to the field: Folsomia candida exposed to a fungicide-based formulation

T.F. Simoes, S.C. Novais, Polytechnic Institute of Leiria / MARE IPLeiria; T. Natal da Luz, University of Coimbra / Department of Life Sciences, University of Coimbra; J. Renaud, CNRS / Functional Ecology; J. Sousa, University of Coimbra / Department of Life Sciences; J. Römbke, ECT Oekotoxikologie GmbH; D. Roelofs, Vrije Universiteit / Department of Ecological Science; N. van Straalen, Association of Retired Environmental Scientists ARES / Department of Ecological Sciences; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria

Folsomia candida is a widespread arthropod that occurs in soils throughout the world and has been used as a standard test organism in past decades for estimating the effects of pesticides and environmental pollutants on non-target soil arthropods. This species is among the most sensitive representatives of its taxon, being selected as a genomic model organism for soil toxicology studies. Although laboratory
experiments with a transcriptomics approach are essential to unravel modes of toxicant action in the two species and to validate the mode of action of benzophenone-3 in a real scenario of soil contamination.
obtained was prepared for gas chromatography. For the exposed fish, there was a significant reduction in egg production, 65%. A high percentage of the eggs presented dark staining, which are not viable. Chromatography analysis revealed significant changes in the amino acid, sterol and fatty acid profile in both tissues, liver and gonads. The results showed a strong impact on the metabolism, egg production and embryo development for the studied fish, which points to the alteration of their reproductive capacity.

WE289
Developing biomarkers of sewage effluent exposure in the freshwater amphiophid Gammarus fossarum
D.R. Canuto, University of Portsmouth / Biological Sciences; T. Werner, Ecotoxicology Group - EPPO Department of Aquatic Toxicology; S. Robson, University of Portsmouth / School of Pharmacy & Biomedical Science; A. Ford, University of Portsmouth / Biological Sciences
Pesticides, pharmaceuticals, industrial chemicals and complexing agents coming from sewage effluents, can be detected in the aquatic environment in very low concentrations. They are able to impact ecological communities, causing biological alterations in many species. Although biomarkers in vertebrates have long been applied, attempts to monitor dysfunctions in invertebrates using orthologous genes have produced inconsistent results. Gammarids are a group of amphipods that have been shown as very sensitive to pollution, having been used in various studies for toxicity evaluation of river waters through exposure to many different chemicals.

However, to date most studies have been focusing on specific life-cycle stages, potentially missing complex interactions among expressed genes not involved in development. The aim of this study is to provide a set of new transcriptomic and metabolomic markers in Gammarus fossarum. After validations in further studies, the new biomarkers found in this project could be used to evaluate the state of aquatic ecological niches and the efficiency of wastewater treatment plants. At WWTPs, biomarkers were sampled from a freshwater stream located in Elgg, Switzerland in September 2017, using standard kick-net method. This stream flows through one industrial WWTP, steadily exposing the whole fauna and flora to a range of pollutants. Sampling was performed 50 m downstream of the WWTP and 50 m upstream, as reference site. Five biological replicates and five technical replicates for both males and females, sampled upstream and downstream were used to get 20 samples containing total RNA. A sub-sample of amphipods was collected for metabolomic analysis and additional samples were fixed to record population markers, such as sex ratio, fecundity rate and potential interspecies phenotypes. The RNA samples have been sequenced by Illumina Genome Analyzer. A differential expression analysis will be conducted to identify significantly different genes between upstream and downstream populations. Subsequently, a comparison between specific biomarkers was carried out, understanding of the biological functions impaired after amphipods wastewater exposure. A biological pathway analysis will be also performed on the differentially expressed genes, allowing a correlation of the impaired molecular pathways after chronic exposure to water pollutants with the chemical mixture found in the wastewater effluent.

WE290
Optimising the algal toxicity test towards generation of multi-omics data and adverse outcome pathway discovery
S. Schade, Birmingham University / Biosciences; N. Taylor, Cambridge Environmental Assessments (CEA) - Ecotoxicology; J. Zhou, S. He, University of Birmingham / School of Biosciences; E. Butler, Unilever; G. Hodges, Unilever / Safety and Environmental Assurance Centre SEAC; J. Colbourne, M.R. Viant, University of Birmingham / School of Biosciences
The adverse outcome pathway (AOP) concept represents a framework to organize mechanistic understanding of toxicological interactions by causally linking critical molecular key events (KEs) to apical endpoints relevant for chemical risk assessment. Currently, only few methodologies can be considered for an accurate and reliable discovery and quantification of KEs in an exhaustive approach, commonly requiring sustained research effort. In this context, the objective of our presented proof-of-concept study was to showcase the identification and characterisation of molecular KEs from the molecular stress response of Chlamydomonas reinhardtii upon sewage effluent exposure. This was in contrast to the comet assay results which suggests a potential genotoxic relationship for sewage wastewater treatments and the highest binary exposures (32, 25 μg/L of Cu and Pb, respectively). Mussels exposed to 25 μg/L of lead showed an increase in acetylcholinesterase activity, this treatment was significantly higher than both the highest copper binary mixtures. The analysis of protein profile is in process which should provide the potential functional effects of exposures of these two environmentally relevant metals, either alone or in combination. Furthermore, once this study has determined the chemical interactions between binary metals and the mussel’s proteome this could pave the way for further omics being performed and adapted for the ability to create early warning environmental indicators, not only for the environmental health but also for human health.

WE292
The Identification of Toxicological Markers in Adverse Outcome Pathway Discovery in Chlamydomonas reinhardtii
G. Reynolds, Unilever / Safety and Environmental Assurance Centre SEAC; S. Schade, Birmingham University / Biosciences; N. Taylor, Cambridge Environmental Assessments (CEA) - Ecotoxicology; J. Zhou, S. He, University of Birmingham / School of Biosciences; E. Butler, Unilever; G. Hodges, Unilever / Safety and Environmental Assurance Centre SEAC; J. Colbourne, M.R. Viant, University of Birmingham / School of Biosciences
Current regulatory toxicity testing methods have become unsuitable for the thorough assessment of chemicals for commercial use, as lack of insight into toxicological mechanisms prevents accurate predictive risk assessment. Adverse outcome pathways (AOPs) provide a framework for identifying and relating molecular KEs coming from sewage effluents, can be detected in the aquatic environment in very low concentrations. It is increasingly recognised that anthropogenic contaminants are not isolated in their threats to the aquatic environment. Recently there has been a shift towards measuring the effects of exposure to low-concentrations chemical mixtures under chronic conditions to predict outcomes on the ecosystem. Adopting an integrated approach the aim of this study was to assess the interactive effects of copper (Cu) and lead (Pb) either alone or as a mixture at various levels of biological organisation, ranging from molecular to individual levels. The combination of proteomics, molecular and physiological measures with bioinformatics adopted in this study will allow a model of mixture exposures to be created which can be translated to early warning indicators within the marine environment.

Elucidating interactive toxic effects of copper and lead on marine mussels: molecular to physiological consequences
C. Crowther, V. Sharma, Plymouth University; A. Turner, Plymouth University / Food Safety; A.N. Jha, Plymouth University / Biological Sciences
It is increasingly recognised that anthropogenic contaminants are not isolated in their threats to the aquatic environment. Recently there has been a shift towards measuring the effects of exposure to low-concentrations chemical mixtures under chronic conditions to predict outcomes on the ecosystem. Adopting an integrated approach the aim of this study was to assess the interactive effects of copper (Cu) and lead (Pb) either alone or as a mixture at various levels of biological organisation, ranging from molecular to individual levels. The combination of proteomics, molecular and physiological measures with bioinformatics adopted in this study will allow a model of mixture exposures to be created which can be translated to early warning indicators within the marine environment. Mytilus galloprovincialis were exposed to a range of concentrations of Cu (5, 32 μg/L) and Pb (5, 25 μg/L) both individually and in a binary mixture. After a 14 day exposure, a number of physiological and molecular parameters were assessed. This included; environmental and toxicokinetics of chemicals, induction of micronuclei (MN), DNA strand breaks (i.e. Comet assay) and measurement of protein profile (i.e. proteomics using LC-MS). The clearance rate shows that the mussels exposed to all treatments containing 32 μg/L of Cu have a significantly decreased feeding capability compared to controls, regardless of singular or binary exposure. This was in contrast to the comet assay results which suggests a potential genotoxic relationship for copper and lead binary exposures (32, 25 μg/L of Cu and Pb, respectively). Mussels exposed to 25 μg/L of lead showed an increase in acetylcholinesterase activity, this treatment was significantly higher than both the highest copper binary mixtures. The analysis of protein profile is in process which should provide the potential functional effects of exposures of these two environmentally relevant metals, either alone or in combination. Furthermore, once this study has determined the chemical interactions between binary metals and the mussel’s proteome this could pave the way for further omics being performed and adapted for the ability to create early warning environmental indicators, not only for the environmental health but also for human health.
WE293 Effects of water-borne benzo[a]pyrene on early-life stages of the fathead minnow (Pimephales promelas)

M.T. Schmitz, RWTH Aachen University; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; N. Sadowski, Norwegian Institute for Water Research / Freshwater Ecology; L.C. Lindeman, Norwegian University of Life Sciences / Dept. for Basic Science and Aquatic Medicine (BasAm); Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxology and Risk Management; J. Kamstra, NMBU / BaSaM; L. Xie, NIVA - Norwegian Institute for Water Research; J. Asselman, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology GHeNToxLab unit; P. Aleström, Norwegian University of Life Sciences; K. Tollefsen, NIVA / Ecotoxology and Risk Assessment

Daphnia magna is used in toxicology and environmental science as a monitor for ecosystem health. Epigenetic analysis is enabled by the genome of the closely related D. pulex. Epigenetic mechanisms allow gene regulation in a developmental context and in response to environmental stimuli. The best studied epigenetic mechanisms are methylation forms on cytosines in a CpG context and post-translational modifications on histone proteins. The global abundance or change of 5-methyl-cytosine (5mC) may indicate epigenetic reactions to environmental stimuli, since these methylation forms facilitate in the regulation of gene expression the change in expression can be detected and compared. The presented integrated ChIP-seq MS code give insight on how these proteins modifications regulate gene expression and crosstalk with each other and with DNA methylation. Chromatin immunoprecipitation (ChIP) is the standard assay for choice for analyzing the genomic localization of histone modifications. Exposure to the Chromatin immunoprecipitation (ChIP) is the standard assay for choice for analyzing the genomic localization of histone modifications. Exposure to the

WE294 SETAC OMICS Interest Group

B. Campos, Unilever R&D / Environmental Chemistry

Epigenetic and evolutionary toxicology: from mechanisms to risk assessment (P)

WE296 Epigenetic effects in Daphnia magna by characterizing quantified abundance of global methylation, gene expression and histone modifications

J. Thaulow, NIVA - Norwegian Institute for Water Research / Freshwater Ecology; L.C. Lindeman, Norwegian University of Life Sciences / Dept. for Basic Science and Aquatic Medicine (BasAm); Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxology and Risk Management; J. Kamstra, NMBU / BaSaM; L. Xie, NIVA - Norwegian Institute for Water Research; J. Asselman, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology GHeNToxLab unit; P. Aleström, Norwegian University of Life Sciences; K. Tollefsen, NIVA / Ecotoxology and Risk Assessment

Daphnia magna is used in toxicology and environmental science as a monitor for ecosystem health. Epigenetic analysis is enabled by the genome of the closely related D. pulex. Epigenetic mechanisms allow gene regulation in a developmental context and in response to environmental stimuli. The best studied epigenetic mechanisms are methylation forms on cytosines in a CpG context and post-translational modifications (PTMs) on histone proteins attached to DNA. The global abundance or change of 5-methyl-cytosine (5mC) may indicate epigenetic reactions to environmental stimuli, since these methylation forms facilitate in the regulation of gene expression the change in expression can be detected and compared. The presented integrated ChIP-seq MS code give insight on how these proteins modifications regulate gene expression and crosstalk with each other and with DNA methylation. Chromatin immunoprecipitation (ChIP) is the standard assay for choice for analyzing the genomic localization of histone modifications. Exposure to the well-known epigenetic modulator, the DNA methylation inhibiting agent 5-Azacytidine, resulted in a global reduction of DNA methylation in Daphnia magna. However, one gene, H3K4me3 and H3K27me3 remains unchanged on the investigated loci. The unchanged response in ChIP was contradictory to significant gene expression responses and to what was expected of this epigenetic modulator. The present study therefore demonstrates differentiated response of LC-MS/MS, ChIP-PCR and gene expression to 5-Azacytidine exposure when characterizing epigenetic stress response in D. magna. Acknowledgements: funding from the Norwegian Research Council (NRC) project 223268 (CERAD).
We further develop the above model by considering the exposure of organisms to mixture of chemicals and nanoparticles. For instance, the exposure dose of copper nanoparticles to tilapia (Oreochromis niloticus) was randomly exposed to 25 nm of copper nanoparticles (0.3 mg/L) under different temperature (26, 28 and 30°C) for periods of 7 days for uptake and 7 days for depuration, to analyze the accumulation of copper nanoparticles on muscle. Results showed that the copper accumulation in muscle in the high temperature group was higher than that of control group on day 7 of uptake phase, but there were not significant difference. For one day of depuration phase, the copper accumulation of the 30°C group was significantly higher than of 26 and 287 groups (p < 0.01). However, they are similar accumulation concentration in the end of depuration period. This study concluded that global warming could increase bioaccumulation of copper nanoparticle in tilapia.


The use of nanotechnology was well developed in recent years, and it lead to the nanomaterials accumulation in the aquatic organism. Otherwise, increased atmospheric carbon dioxide causing the phenomenon of global warming. However, little is known about the effects of warming whether increases the bioaccumulation of copper nanoparticles in freshwater fish. The purpose of this study is to assess whether warming synergistically increase the bioaccumulation of copper nanoparticles in tilapia (Oreochromis niloticus). T. Strauss, University of Siena / Department of Physical, Earth and Environmental Sciences; A. Ale, Inalı-Conicet; C. Jimena, Instituto Nacional de Lluminología (CONICET-UNSL); S. Ancora, University of Siena / Physical sciences, Earth and environment; N. Bianchi, University of Siena / Department of Physical, Earth and Environmental Sciences; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences.

The use of nanotechnology-based consumer products is constantly increasing worldwide and their release into the environment is thus expected, especially in aquatic ecosystems, which are considered the ultimate sink. The use of nano silver (AgNP) based products as antimicrobial agents is undergoing a rapid increase in terms of production due to its biocidal properties. Here we studied the impact of AgNP-based commercial products named NanArgen (Nanotek S.A.) on a common marine bivalve shellfish species as the Mytilus edulis of different sensitivity to the impact of biological responses and Ag accumulation. Animals in vivo exposed for 96h to NanArgen product containing 20-40nm AgNP, according to the manufacturer, at two different concentration (1 μg and 10 μg/L) using natural sea water (NSW) as exposure media. Lysosomal membranes stability (NRRT) and micronuclei frequency (MN) were measured in mussel’s hepatocytes. Catalase (CAT) and glutathione-s-transferase (GST) activities were measured in digestive gland as well as the content of malondialdehyde (MDA) and metallothioneins (MT). Effect on multi xenobiotic resistance (MXR) phenotype was assessed by measuring efflux ABC transporters also in vitro using mussel’s gills. Total Ag was analyzed in exposure waters after 24h and in mussel’s soft tissue after 96h. DLS analysis as well as TEM have been also performed on NanArgen formulation in NSW. A significant increase in lysosomal destabilization and MN frequency was observed in hemocytes of mussels exposed to both concentrations of NanArgen. Furthermore, MT content was significantly higher in digestive gland of mussels exposed only to 10 μg/L while oxidative stress parameters did not show any change compared to controls. A slight negative effect on MXR functionality is observed in vivo and in vitro. Catalase activity is significantly decreased in vivo. A dose-dependent increase of Ag in exposed mussels. In conclusion we can state that this nano silver-based commercial product can induce toxicity even at low concentrations and in short-term exposure scenarios. The observed toxicity of NanArgen underlines the need to further test commercial formulations of nanotechnology-based consumer products instead of bare nanoparticles in order to properly address any risk associated to their use and release into aquatic environment and in non-target aquatic species.

WE303 Effect of gold nanoparticles on feeding, growth and enzymes activity of amphibians B. Rafaela Costa 1, Department of Biology & CESAM - University of Aveiro / Biology; C. Quintaneiro 1, Department of Biology & CESAM - University of Aveiro; A.M. Soares 1, University of Aveiro / department of Biology & CESAM; I. Lopes, Department of University of Aveiro / Department of Biology & CESAM; 3810-193 Aveiro. The gold nanoparticles are widely used in medical therapy and cosmetics. In the last years, the scientific community has been interested in the relative abundance of papers focusing on engineered nanoparticles, including both freshwater and saltwater species. The knowledge about the potential ecotoxicity of these nanoparticles is essential because their use by society at a large scale, since they will ultimately be released in to the environment. Thus, the aim of this study was to determine the effect of gold nanorods (Au-NRs, 45nm) in the feeding rate, growth and enzymatic activity of the feeding amphibian species Rana temporaria. A significant decrease in feeding rate and snout to vent length (SVL) of tadpoles was observed at concentration equal or higher than 0.004 μg/ml. For biomass a significant effect was observed at concentration 0.007 μg/ml or higher, though, a decrease in weight gain rate was observed at a lower concentration (0.004 μg/ml). At the biochemical level, the activity of enzyme lactate dehydrogenase (LDH) increased at 0.002 μg of Au- NR, that of catalase (CAT) was significantly reduced at 0.005 μg/ml or higher, and glutathione S-transferase (GST) and acetylcholinesterase activity (AChE) were significantly higher, relatively to the control, in the two highest tested concentrations 0.007 and 0.01 μg/ml. The
observed reduction in SVL, added to decreased feeding rates, in tadpoles exposed to Au-NR, are important effects that may compromise the fitness of the organisms, since they may cause a delay in the metamorphosis, leading to a longer exposure period of tadpoles to the chemical and to an increase in the time to reach adult and reproductive stage. The higher activity of LDH, at 0.002 μg/mL, may suggest that tadpoles activate first (at low concentrations of Au-NR) a detoxification pathway involving the liver. Furthermore, an elevated reactive oxygen species (ROS) may have led to the inactivation of extracellular calcium channels related with the mechanisms of cell apoptosis. Thus, the induction of GST at the two highest Au-NP concentrations, suggest that the cells are inactivating the Au-NP by its conjugation with reduced glutathione. The results obtained in the present work indicates that Au-NR may induce several sublethal effects in tadpoles of X. laevis, compromising their fitness. Furthermore, since these effects occur at very low concentrations (as low as 0.002μg/mL) it should be classified as "extremely toxic" (EC20 < 0.1 μg/mL; CEC, 1996), suggesting a high environmental risk.

WE304 Interaction of the biocide triclocarban and weathered multiwalled carbon nanotubes (wMWCNT) in freshwater algae: chronic effects & bioaccumulation

L. Poliowski, M.P. Hennig, H. Hollert, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

The disposal of various plastic nanocomposites containing multiwalled carbon nanotubes, which is expected to increase in the next decades. Thus, MWCNT release into the aquatic environment due to degradation of the polymers is inevitable. Changes in their properties might happen by several abiotic influences, like weathering by sunlight radiation. MWCNT undergo further structural changes compared to their pristine state, like formation of hydroxyl and carboxyl groups on the surface of the MWCNT. As a consequence, weathered MWCNT (wMWCNT) have been used to study alteration in a gelatin-like matrix and sorption of contaminants like triclocarban (TCC). This might lead to a different environmental fate of both the wMWCNT and the contaminants in aquatic ecosystems and eventually an enhanced chronic or mixture effect on organisms like freshwater algae. In our studies we examine the chronic effects of wMWCNT and the 'Trojan horse' effects of TCC in presence and absence of wMWCNT on Pseudokirchneriella subcapitata and Chlamydomonas reinhardtii. Growth inhibition tests were performed according to OECD test guideline 201. In a first part of experiments, the growth inhibition of both species was tested in the range of 10 – 60 µg/L for TCC and 0.1 – 16.0 mg/L for wMWCNT. The mixture toxicity of a TCC test series (10 – 60 µg/L) and 100 µg/L wMWCNT was additionally investigated on P. subcapitata. A second series of experiments was carried out by adding the highest TCC concentration (60 µg/L) to variable wMWCNT concentrations to figure out, which wMWCNT amounts are necessary to reduce the toxicity of TCC. We determined a concentration dependent growth inhibition of P. subcapitata for TCC and TCC + 100 µg wMWCNT/L with an Ec50 of 37 and 36 µg TCC/L, respectively. This amount of wMWCNT appears to be not sufficient to adsorb the entire free TCC from the water phase, which eventually leads (wMWCNT) to similar Ec50 values in both scenarios. Only in a second experiment it could be shown, that wMWCNT amounts > 1 mg/L reduce algae growth inhibition completely caused by 60 µg TCC/L. Regarding to mixture effects of TCC and wMWCNT to algae, bioaccumulation of wMWCNTs by freshwater algae needs to be investigated, especially in regard to long term incubation times and low wMWCNT amounts. Acknowledgments The work is supported by the European Programme of Environment Transfer that receives funding from the Bundesminister für Bildung und Forschung (BMBF) under agreement with the FP7 ERA-NET SIINN.

WE305 Comparative assessment of the interactive effects of Carbon-based nanomaterials and Benzo(a)pyrene on zebrafish embryos

C. Della Torre, State University of Milano / BioSciences; A. Ghilardi, S. Magni, University of Milan; N. Santo, University of Milan / BioSciences; D. Maggioni, University of Milan; C. Landi, University of Siena; M. Parolini, University of Milan / Department of Environmental Science and Policy; L. Madaschi, University of Milan / Biosciences; L. Bini, University of Siena; L. Del Giacco, University of Milan; A. Binelli, University of Milan / Department of Biosciences

This study aimed to assess the ecotoxicological consequences related to the interaction of Benzo(a)pyrene (B(a)P) with two CNMs with different physico-chemical properties, namely carbon nanopowder (CNPW) and fullerene (C60). The objective of this aim is to study the influence of the contaminants and the effective sorption of the hydrocarbon on CNMs was quantified. A thorough evaluation of chemico-physical interactions between the two CNMs and B(a)P has been performed. Embryos were exposed to CNPW, C60 and B(a)P alone and their combination. The uptake of CNMs and B(a)P and their localization in embryos were assessed by immunofluorescence and electron microscopy. To evaluate the toxic effects, due to interaction of B(a)P with CNMs, a set of biomarkers of genotoxicity and oxidative stress was applied. Proteomics analysis allowed also the identification of molecular events involved in the responses to pollutants alone and in co-exposure. Overall results showed that the different physico-chemical properties of the two CNMs influenced their interactions with B(a)P and generated different toxic effects. Indeed the adsorption on CNPW modified the accumulation of B(a)P, which followed the distribution of the physical pollutant instead of its natural bioaccumulation. On the contrary the co-exposure with C60 did not affect the uptake/distribution of B(a)P. Instead, C60 doped with B(a)P is more prone to sedimentation and less bioavailable for the embryos compared to C60 alone. The integrated results from biomarkers and proteomics showed that different stress responses were induced by the combination of ZnO-NPs and B(a)P alone in their combination. The CNP with doped with B(a)P mainly mirrored the effects shown by the physical contaminant rather than by the hydrocarbon, while C60 doped with B(a)P seems to induce a cellular response similar to B(a)P alone. The study highlighted that in the aquatic ecosystems complex interactions are established between pollutants and CNMs which could elicit unexpected ecotoxicological effects.

WE306 IN VITRO TOXICITY OF MODEL ZnO NANOPARTICLES ON HEMOCYTES OF MUSSELS Mytilus galloprovincialis

I. Politowski, University of Patras / Department of Environmental and Natural resources Management; N. Anastasi-Papathanasi, University of Patras / Department of Biology; E. Mouzouarakis, Y. Georgiou, University of Ioannina / Department of Physics; S. Dailianis, University of Patras / Department of Biology; Y. Deligiannakis, University of Ioannina / Department of Physics; D. Vlastos, University of Patras / Department of Environmental and Natural resources Management.

Zinc oxide nanoparticles (ZnO NPs, size 58 nm, as calculated using X-Ray diffraction data) were manufactured through Flame Spray Pyrolysis, and their effects were subsequently investigated on hemocytes of mussels Mytilus galloprovincialis. Following the collection and preparation of cell suspensions, mussel hemocytes were treated for 1 h with different concentrations of ZnO-NPs (5, 10, 25 and 50 mg L-1). The bioaccumulation of ZnO-NPs and metal ions (Zn2+) was measured by ICP-MS. Hemocytes treated with sub-lethal concentrations of ZnO-NPs (5-25 mg L-1), showed a significant increase in the metal ions uptake, while the metal ions concentrations were almost constant in control cells in each case. Finally, the results of the exposure to ZnO-NPs were compared with the respective results after exposure to ZnCl2, showing a similar pattern. Those effects of ZnO-NPs on mussel hemocytes confirm the cytotoxic and oxidative potential of well-promised nanomaterials, such as ZnO-NPs, widely used in a variety of new cutting-edge applications.

WE307 Toxico-transcriptomics as tool to identify nano-specific toxicity profiles

M. Burdak, Eawag Aquatic Water Science / Southern Ocean Persistent Organic Pollution Program; A. Betz, Eawag / UTOX; K. Schirmer, Eawag / Environmental Toxicology; A. Zupancic, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environment Technology / Environment Management.

The use of omics is rapidly increasing in the field of nano-ecotoxicology; an increasing number of studies are aiming to investigate the effects and mode of action of engineered nanomaterials (ENM) in this way. However, a systematic synthesis of the outcome of these studies in order to identify common responses between ENM and organism groups has not yet been performed. We therefore established a computational analysis pipeline with the aim to re-analyze relevant transcriptomic datasets in a consistent manner. The pipeline allows a re-mapping of probe sequence following, by established statistical analysis and thus improves data set comparability. Differentially expressed genes (DEGs) are determined by comparison between treatment and untreated samples (pFDR < 0.05).

WE308 Zinc toxicity to A549 cells and Daphnia magna changes with iron oxide nanoparticles

J. Cabellos, LEITAT Technological Centre; V. Gonzalez, Leitat Technologiical Center; M. Almira-Casellas, Leitat Technological Center / HEHS; M. Diaz-Ortiz, G. J. Janer, Leitat Technologic Center; M. P. Hennig, H. Hollert, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics.

The use of iron oxide nanoparticles (IONPs) as an environment remediation tool is based on their ability to adsorb and immobilize metals and decrease their bioavailability. However, the adsorption of metal contaminants by nanoparticles can also potentially increase the toxicity of either NPs or the metals, for example due to the Trojan horse effect. In this study, we evaluated the acute effect of zinc (Zn) as zinc sulphate heptahydrate (ZnSO4·7H2O) after an incubation period with a fixed concentration of humic acid (ha) coated IONPs (ha-IONPs), on the in vitro toxicity to human A549 cells and on the toxicity to Daphnia magna as a model freshwater invertebrate species. Non-toxic concentrations of ha-IONPs were selected for the
assays taking also into account the predicted adsorption of Zn. The ha-IONPs concentrations used were 0.45g/L and 0.52 g/L for the A549 and the Daphnia magna experiments, respectively. In A549 cells, the incubation of Zn with ha-IONPs did not change the Zn effects on cell viability after 24h in terms of IC50 (0.006 g/L vs 0.010 g/L with and without ha-IONPs, respectively). However, the shape of the dose-response curve became shallower (e.g., the IC50 for Zn was 0.070 g/L without and 0.015 g/L with ha-IONPs, respectively). This indicates a potential protective effect of IONPs at high metal concentrations and a synergistic effect at low metal concentrations. These experiments were also conducted in the presence of serum proteins, and despite the toxicity of Zn decreased, the same effect of co-incubation with ha-IONPs was observed. Optical microscopy images showed that ha-IONPs aggregates were uptake by the cells during the experiments. Therefore, even if adsorbed on ha-IONPs, NMs would reach intracellular compartments. Differences in the relative uptake of free vs. ha-IONP adsorbed zinc as well as intracellular bioavailability of Zn in these two forms would be explaining the changes in the dose-response curve that were observed. Acute studies (up to 48-hours) with Daphnia magna showed a protective effect of the ha-IONPs on the toxicity of Zn. The EC50 value for Zn increased from 0.23 mg Zn/L to 1.1 mg Zn/L in presence of ha-IONP. According to DLS data, the adsorption of Zn to NPs decreased their stability and subsequently increased their adsorption in the exposure media. This settling process would decrease the bioavailable zinc concentration in the exposure medium and therefore its toxicity in Daphnia magna.

WE309 Internalization of graphene-related nanomaterials in fish cell lines

The H2020 NanoReg2 project aims to develop and implement grouping and Safe by Design strategies for nanomaterials (NMs). For this purpose, toxicity of selected carbon-based NMs have been assessed in order to refine Safe by Design approaches considering three pillars: safer product, safer use, and safer production process. Graphene-related nanomaterials (GNMs) are among the newest and most important NMs in the last decade. Unlike other NMs, GNM-based NMs have attracted great interest in most areas of science and industry. Nevertheless, the incorporation of these NMs into products inevitably leads to their release into the aquatic environments. In a previous study we assessed the cytotoxicity of tubular-shaped carbon nanofibers (CNFs) and graphene oxide (GO) on fish hepatocytes (derived from topminnow fish, Poecilia latipinna) and macrophages (derived from carp leucocytes, Cyprinus carpio) in general. In the present work we focussed on the uptake and intracellular fate of these NMs. Cells were exposed to three different concentrations (non-toxic, low toxic and relatively toxic) of each NM for 72 h. Transmission electron microscopy was used to investigate possible internalization and intracellular fate of these NMs in hepatocytes and macrophages. All GNM were internalized by hepatocytes and macrophages even at the lowest exposure concentrations. Carbon nanofibers were taken up into vesicles of hepatocyte cells in a size-independent manner, whereas in macrophages, longer CNFs were encountered free in the cytoplasm and only the shorter CNFs were localized in membrane-bound compartments. GO sheets were present within vesicles as well as free in the cytoplasm of both cell types. Understanding the behaviour of these NMs in the aquatic environment is important for adaptation of safer materials for the environmental. This research is supported by the EU’s Horizon 2020 research and innovation programmes (NanoReg2, Grant Agreement nº 646221 and MSCA IF-2016, Grant Agreement nº 746876).

WE310 Molecular mechanism and physicochemical properties of Cadmium-TiO2 nanoparticle mixtures when co-exposed to the nematode Caenorhabditis elegans
L. Kleene, Hamburg University of Applied Sciences (HAW) / Life Sciences; A. Hursthouse, University of the West of Scotland / School of Science; S. Heise, Hamburg University of Applied Sciences / School of Science.

The number of engineered nanomaterials (ENM) is rising continuously in consumer products and industrial fields. Therefore, knowledge about their ecotoxicity in living systems aid in designing safer materials for the environment. This research investigates the interacting effects of temperature and salinity on ZnO NP, in two freshwater microalgae: Chlorella vulgaris and Raphidocelis subcapitata. These species were exposed, for four generations (F1 to F4), to the respective Au-NR concentration causing 10% reduction in growth rate (EC10Au-NR) computed for all generations of each alga. The impact of nTiO2-NPs with temperature and salinity, from which it will be able to determine any potential interactions. This study, therefore, investigates the interacting effects of temperature and salinity on ZnO-NP to a common marine copepod (Tigriopus japonicus) along the Western Pacific coast. Physicochemical properties (aggregate size & ion dissolution) of three zinc-associated compounds, including ZnO-NP, ZnO bulk-particles (ZnO-Bulk) and ZnSO4·7H2O (ZnSO4) were characterized to compare their toxic mechanisms. Acute toxicity was determined with 96-h standard toxicity tests under nine different combinations of temperatures (15, 25 & 35 °C) and salinity (12, 22 & 32 PSU), i.e., a 3 x 3 factorial design. Preliminary results showed that increase in temperature and salinity could increase aggregate size of ZnO-NP and ZnO-Bulk, but reduce their ion dissolution rate. At 25 °C, similar to previous studies which suggest that [ZnO-NP] and [ZnO-Bulk] are not affected. However, these two forms would exhibit a different behavior, where ZnO-NP was the least toxic at 22 PSU, where the dissolution rate of Zn2+ was the smallest. ZnSO4 was the least toxic compound, implying that Zn2+ were not the only contributor to the observed toxicity. Higher toxicity of ZnO-NP and ZnO-Bulk might be due to particle and animal interactions such as physical damage by larger aggregate at larger salinity. The results will advance our understanding of interactions of ZnO-NP and ZnO-Bulk with organisms from which it will be able to determine effect threshold concentrations for regulation of products of ZnO-NP under different combinations of these two environmental factors.

WE312 Multigenerational effects of gold nanorods to Raphidocelis subcapitata and Chlorella vulgaris
C. Monteiro, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; C. Venâncio, Department of Biology / Biology; A.L. Daniel-da-Silva, S.F. Soares, University of Aveiro / Department of Chemistry / CICECO; A.M. Soares, University of Aveiro / department of Biology & CESAM; T. Trindade, University of Aveiro / Department of Chemistry / CICECO; L.L Coelho, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro.

In real scenarios, exposure to nanoparticles may occur over several generations, which may exhibit a higher sensitivity (due to the accumulation of adverse effects) or tolerance (due to phenotypic plasticity mechanisms) to the nanoparticle. The aim of this study was to evaluate the multigenerational effects of gold nanorods (Au-NR) ranging from 8 to 90 μg/mL, for 72h. At the end of the assays, growth rate computed for all generations of each alga. The following physico-chemical parameters of Au-NR concentrations were monitored: size, morphology and total concentration of Au. In addition, the toxicity of the capping agent...
The effects of climate change combined with copper nanoparticle on early development of Japanese medaka (Oryzias latipes) I. Meng Ian, Y. Zhang, W. Chen, Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung Nowadays, global warming and acidic acidification were occurred by rising carbon dioxide (CO$_2$). The factory have been continuously emit copper nanoparticle into ocean and river. They probably induced harmful biological effect to organisms. However, the combined effects of three environmental stressors on aquatic species have not been well studied. The purpose of this study is to assess the effects of aquatic acidification and warming combined with copper nanoparticle on survival and hatchability of early development of Japanese medaka (Oryzias latipes). Firstly, the embryos were exposed to CuNP (25 nm, 0.03 mg/L) and without copper nanoparticle under nine temperature and pH conditions (26°C/7.5, 26°C/6.5, 26°C/5.5, 28°C/7.5, 28°C/6.5, 26°C/5.5, 30°C/7.5, 30°C/6.5 and 30°C/5.5) for 14 days to observe hatchability and mortality. Then, the newly hatched fry were exposed to same condition for 14 days to observe the survival. Results showed that the mortality of embryos had a upward trend, and the hatching rate had a down trend in exposure group of pH 5.5 compared with that of others pH groups. However, only 28°C/5.5 combined with copper nanoparticle group was significantly increased mortality and inhibited hatchability than that of 28°C/6.5 combined with copper nanoparticle group. While the survival rate of larvae had a significantly downward trend in exposure groups of lowest pH level and highest temperature on days 10. In conclusion, aquatic acidification and warming were synergistic effect to increase copper nanoparticle toxicity to larvae. Therefore, we found that three environmental stressors caused a potential hazards to fish population.

The use of the marine mussels Mytilus hemocytes as a model for studying the impact of NPs on innate immunity M. Auguste, University of Genova / DISTAV; T. Bai, L. Canesi, university of genou / DISTAV Nanoparticles (NPs) are widespread used in consumer products and industry; they are the following interest for their potential applications in medicine, energy, agriculture and consumer goods production. In this research, the combined toxicity of heavy metals (Cu, Zn) and nanoparticle (CuNP) to the marine mussels Mytilus galloprovincialis was evaluated in a benthic estuarine microalgae - Cylindrotheca closterium. We hypothesize that the aggregates formed by the metal-oxide nanoparticles may adsorb the free metal ions, reducing the bioavailable fraction available for interaction (of the algae, we also investigate whether reduced light intensity (shading effects) as a result these aggregates may be a potential mechanism of ENMs toxicity in benthic aquatic organisms.

Comparative toxicity of silver nanocolloids and titanium dioxide nanoparticles using medaka Y. Kato, Toyo University / Faculty of Life Science; T. Ariyoshi, C. Kataoka, S. Kashiwada, Toyo University / Graduate School of Life Sciences Silver nanoparticles and titanium dioxide nanoparticles are representative nanomaterials and mass-produced with multiple potential consequences to human life. Hence, environmental fate and unintentional ecological effects and/or toxicities have been concerned and many studies are reported using model organisms. We have been investigating fish toxicity and ecological risk of silver nanocolloids (SNCs, 40 nm) using medaka model. SNCS have hemolytic (at 0.5 mg/L of SNC) and larvae (at 5 mg/L of SNC) toxicities including lethality, inhibition of embryo development, and shortened length. Small eye development, ischemia, reduced heart beating, and caused some oxidative stresses such as GSH reduction and lipid peroxidation. To adults, SNCs exposure (at 5 mg/L) did not exhibit significant lethality; however, it was observed that SNCs exposure (at 0.05 mg/L) disrupted immune system and reduced tolerance to infective bacterial disease (Edwardsiella tarda). In SNCs exposure, we resulted that silver chloro-complexes, which were made of dissociated silver ion from SNCS, should be essential toxicants of SNCs exposure. On the other hands, titanium dioxide nanoparticles (TiO$_2$NP, Φ = 90 nm) are well-known causing oxidative stress by UV radiation; however, there are some reports that TiO$_2$NP does not have significant toxic effect to fish other than
hypertrophy of gill mucus. We have assumed that ion dissociation will be a key to understand nano-toxicity depended on materials. TiO$_2$-NP which does not dissociate ions, was employed as a reference to ion dissociation NP (i.e. SNPs). In exposure of TiO$_2$-NP (at 10 mg/L) to embryo and larvae, there was no biological toxic effect mentioned above at all. In our presentation, we will discuss comparative toxicity of SNPs and TiO$_2$-NP regarding general toxicity, oxidative stress, cystostasis (apoptosis and necrosis), immuno-toxicity, and tolerance to a toxicant in aquatic biological system. Through this study, we will figure out that dissociated ions must be toxic essential of nanomaterials, and not always nano-sized material will be toxicant in aquatic environment.

WE318
Genotoxicity assessment of aluminium oxide nanoparticles in relation to Escherichia coli and Aeromonas hydrophila
n. doskocz, M. Zalańska-Radziwill, A. Affleck, Warsaw University of Technology, Faculty of Building Services, Hydro and Environmental Engineering / Department of Biology

Increasing production and use of nanoparticles contributes to their widespread dissemination in the environment and their unique physical and chemical properties lead to unlimited distribution in environmental compartments. Migration ability of nanoparticles can have very dangerous consequences, as they can be transferred to potable water. Genotoxicity biomarkers are regarded as useful tools for the assessment of chemical hazards in aquatic ecosystems, because chemicals which damage DNA can significantly alter the functioning of ecosystems. Recent advances in molecular biology have led to the development of several techniques, which can be used for DNA analysis in the field of genetic toxicology. The randomly amplified polymorphic DNA (RAPD) method is a PCR-based technique that amplifies random DNA fragments with the use of single short primers of arbitrary nucleotide sequence under low annealing conditions. RAPD-PCR test has been used successfully for detection of genetic damage in animals and plants. The SOS-Test is one of the most commonly used bacterial tests. It is based on the induction, by genotoxic compounds, of a bacterial SOS repair system conjugated to the b-galactosidase gene and the subsequent measurement of the enzyme expression. In this work, genotoxicity studies on the basis of the RAPD-PCR and SOS-Chromotest assay were performed for aluminium oxide nanoparticles (nAl$_2$O$_3$). Luteins on the fate, transport, and effects of nanomaterials, including metal based particles such as nAl$_2$O$_3$, in the environment. The interest in nAl$_2$O$_3$ is due to the fact that their influence on genetic material of bacteria is practically unknown. Results obtained for the nanocompound were compared with those for Al$_2$O$_3$ macro. The nanocompound caused changes in the genetic material of bacteria A. hydrophila. Decrease in the genetic stability of obtained bacterial strains was observed relatively to the control. No significant effects were observed for the negative control by more than 27.3%, while from positive control - only by 15.6%. Furthermore, the largest decrease in genetic stability was 89.3%. The values of genotoxicity induction coefficient (I) in the SOS-Chromotest showed strong genotoxicity for nAl$_2$O$_3$, in the presence of S9 fraction and slight genotoxicity in the absence of S9 fraction in mutants of Escherichia coli. The results showed also that nAl$_2$O$_3$ can induce genotoxicity a greater extent than the same compounds in their macro form.

WE319
Effects of Copper Oxide Nanoparticles and Arsenic on the Whole-Life Cycle of Rice (Oryza sativa japonica)
I. M. Simms, G. P. Cobb, Baylor University / Department of Environmental Science

Copper oxide nanoparticles (nCuO) and arsenic (As) phytotoxicity to rice plants (Oryza sativa japonica) was evaluated in a factorial study using (0, 0.1, 1.0, 10, 50, and 100 mg/L) in daily watering and As (0 and 10 mg/kg) in soil. Experiments were conducted in a greenhouse during 130 day interval. Two rice plants were grown in 3L plastic pots without drainage. Toxictants were quantified in soils and water by inductively coupled plasma-mass spectrometry before, during and after testing. nCuO particle sizes were determined by differential light scattering before addition to the test system. Exposures began at planting, continued through germination, and to seed production. Thus, our study is the first to examine the influence of nCuO in combination with As in the whole life cycle growth of rice plants. No significant effect was observed on the seed germination, but both nCuO and As had a significant main effects on the fresh weight (FW) of rice straw and the number of rice panicles (NRP). The interaction of the two toxictants was also significant on both FW and NRP. A decrease in the FW was observed for rice exposed to As, only. The midlevel concentrations (1.0 and 10 mg/L) of nCuO decreased the FW with no As addition, while higher concentrations (50 and 100 mg/L) significantly increased the NRP. Low and high nCuO concentrations (0.1, 50, and 100 mg/L) decreased the FW with the As addition, and NRP decreased in treatments receiving As along with either lower or higher nCuO concentrations. More data from this greenhouse study are currently being compiled and analyzed to determine the effect of As and nCuO on grain yield as well as Cu and As uptake, distribution, and speciation in rice plants and the grain.

WE320
Behavior of cerium oxide nanoparticles in presence of pharmaceuticals

compounds on aquatic specimens
G. AMARIEL, Universidad de Alcala; K. Boltes, Universidad de Alcala / Chemical Engineering; P. Letón, Universidad de Alcala

Nanoparticles, in particular metal oxide nanoparticles, have found extensive usage in a wide range of services and industries. Subsequently, they can be released into the environment and finally end up in water bodies. That may cause a potential risk to aquatic environment, exerting toxic effects at the level of cells, tissues or the whole organisms. The present study, evaluates the toxicity behavior of cerium oxide nanoparticles (CeO$_2$-NPs) on three aquatic specimens- algae Selenastrum capricornutum, bacteria Vibrio fischeri, and activated sludge, by exploring concentration-dependent effect and changes induced due to the presence of Ibuprofen (Ibu) or Levofloxacin (Levo). 72h algae growth-inhibition, marine bacteria- luminescence reduction and 24h sludge enzymatic activity and oxidative stress were used as endpoints. Nanoparticles concentration ranged from 0.6 to 160 mg L$^{-1}$. The particle size and the type of NPs in the culture media were measured to analyse the relation between stability profile and the observed toxicity behavior. The obtained results reveal toxic effects of CeO$_2$ nanoparticles leading to growth inhibition in algae. The presence of Ibu did not produce significant changes, while Levo showed drastic negative effect in algae growth. Short-term exposure produced significant reduction of luminescence intensity in marine bacteria. The presence of both, Ibu or Levo, reduced the negative effects of single nanoparticles in Vibrio fischeri. Exposure produced significant oxidative stress in bacteria forming activated sludge, with lower damage to enzymatic activity. The presence of pharmaceutical compounds did not produced significant changes on nCuO toxicity in both in dietary and water exposure routes. For this, neonates of D. longispina were exposed to a control and to three different nTiO$_2$ (at 0, 0.1, 1.0 mg/L) concentrations. Results indicated that algae was more strongly affected than the marine bacteria and activated sludge, respectively. These can be attributed to the culture media and organisms structural characteristics, respectively. [1] Neale PA, Jantke AK, O'Malley E, Herrmann J, Escher BI. 2015. Behaviour of titanium dioxide and zinc oxide nanoparticles in the presence of wastewater-derived organic matter and implications for algal toxicity. Environmental Science & Technology. [2] Sahle-Demessie E, Changseok H, Amy Z, Bill H, Heidi G. 2016. Interaction of engineered nanomaterials with hydrophobic organic pollutants. Nanotechnology 27:284003. Acknowledgement - The research was funded by the Comunidad de Madrid, grants S2013/MAE_2716 REMFAVARES.

WE321
Toxicity of nanoparticles of titanium dioxide to Daphnia longispina: waterborne versus dietary exposure
E. Padilla, Institute for Environmental Sciences / University Koblenz-Landau; C. Venancio, Department of Biology / I. Lopes, University of Aveiro / Department of Biological Sciences / R. Vitkus, Nature Research Centre (Lithuania)

Removal of single-walled carbon nanotubes (SWCNTs) and TiO$_2$-NPs) on three aquatic specimens Daphnia longispina, either through waterborne or dietary exposure routes. For this, neonates of D. longispina were exposed to a control and to three different nTiO$_2$ (at 0, 0.1, 1.0 mg/L) concentrations. Results indicated that algae was more strongly affected than the marine bacteria and activated sludge, respectively. These can be attributed to the culture media and organisms structural characteristics, respectively. [1] Neale PA, Jantke AK, O'Malley E, Herrmann J, Escher BI. 2015. Behaviour of titanium dioxide and zinc oxide nanoparticles in the presence of wastewater-derived organic matter and implications for algal toxicity. Environmental Science & Technology. [2] Sahle-Demessie E, Changseok H, Amy Z, Bill H, Heidi G. 2016. Interaction of engineered nanomaterials with hydrophobic organic pollutants. Nanotechnology 27:284003. Acknowledgement - The research was funded by the Comunidad de Madrid, grants S2013/MAE_2716 REMFAVARES.

WE322
Dynamics of Cu accumulation in charophyte cell compartments after its exposure to nCuO
Manusdarshan, NatureResearchCentre / Institute of Botany, Laboratory of Aquatic Ecotoxicology; B. Gylety, S. JURKONIENE, R. Vitkus, Nature Research Centre / Institute of Botany

In plant and bacterial cells, prior to be internalized, NPs have to pass semipermeable cell wall and plasma membrane barrier. Metal nanoparticles may interact with the cell directly or indirectly induce toxicity through the release of metal ions. Internodal cell of characean green alga poses features such as big size and separation of the main cell compartments, which enable mechanical separation of the compartments, namely cell wall, cytoplasm and vacuole. In this study, fractionation procedure was verified by cyttoplasm and vacuole specific biomarkers,
malate dehydrogenase and α Mannosidase, respectively. A high-purity vacuumolar (99.5%) and cytoplasm (86.7%) fractions of the cells of Nitzschia obtusa were obtained. The cell wall fraction contained approximately 1.8 and 13.4% of cytoplasm and vacuole. By additional washing of the cell wall it was possible to diminish contamination with cytoplasm. The data on Cu accumulation dynamics within the compartments after cell exposure to rCuO suspensions will be presented and the role of the cell wall in the accumulation process will be discussed.

WE323 Are graphene nanomaterials "Trojan horse" carriers for oil compounds in mussel hemocytes in vitro?
G. Niccolussi, University of the Basque Country / CBBT Research Group, Dept. Zoology and Animal Cell Biology, Science and Technology Faculty and Plentzia Marine Station, University of the Basque Country (UPV/EHU), Basque Country, Spain; A. Katsumi, M.P. Cajaraville, University of the Basque Country / CBBT Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE
In the aquatic environment, complex mixtures of pollutants are usually found. Polycyclic aromatic hydrocarbons (PAHs) are priority pollutants and main constituents of the water accommodated fraction (WAF) of petroleum. Graphene nanoplatelets can adsorb organic compounds thus being potentially useful in oil spill remediation. However, they could also act as vehicles of organic contaminants to aquatic organisms ("Trojan horse" effect). This study aimed to evaluate the "Trojan horse" carrier effect of graphene nanoplatelets. This work was funded by the EU H2020 (GRACE project [grant 679266], Spanish MINECO (project NACE, CTM2016-77256R-C3-2-R) and the Basque Government (consolidated research group IT810 926). The current research suggests that graphene nanoplatelets may act as "Trojan horse" carriers for oil compounds. This work was funded by the EU H2020 (GRACE project [grant 679266], Spanish MINECO (project NACE, CTM2016-77256R-C3-2-R), and the Basque Government (consolidated research group IT810 926). The current research suggests that graphene nanoplatelets may act as "Trojan horse" carriers for oil compounds. This work was funded by the EU H2020 (GRACE project [grant 679266], Spanish MINECO (project NACE, CTM2016-77256R-C3-2-R), and the Basque Government (consolidated research group IT810 926).

WE324 Multigenerational effects of titanium dioxide and silver nanoparticles on Daphnia magna: gene expression and morphological changes in the presence or absence of aged nanomaterials
L.A. Ellis, The University of Birmingham / GEE, E. Valsami-Jones, University of Birmingham / School of Geography Earth and Environmental Sciences; I. Lynch, University of Birmingham / Geography Earth Environmental Science.
Recent studies have investigated nanoparticle (NP) physiochemical properties and interactions with biological systems. Daphnia magna was chosen as the model organism, as they are well characterized and reproduce parthenogenetically, which is well suited for experimental genetic studies and monitoring stress/adaptive change to their environments. Herein, we investigated key biological endpoints, such as growth, survival, growth, reproduction, and a primary pathways in response to exposure to silver (AgNPs) and titanium dioxide (TiO2) nanoparticles (NPs). Particles were either pristine or aged, uncoated or stabilized with either PVP or sulphide (AgNPs only). Our aims were to identify specific stress responses from NPs which could lead to molecular effects in order to understand if: (1) different NP compositions induce the same pathways and effects; (2) exposure in different nanoparticles elicits such as natural organic matter changes the pathways and/or severity of changes observed; (3) if the ageing of particles make them more or less toxic; (4) if long-term dose exposure (25 days, EC20 concentrations) leads to developmental and reproductive changes, and (5) whether these NP-exposure induced changes to the F0 generation are passed onto subsequent generations, who themselves are not exposed directly. In all cases, both morphological changes and expression of key biomarkers were analysed in order to identify whether chronic exposure to NPs induces stress responses. We observed morphological changes, including eyes and tail defects, to each of the subsequent F1-F3 generations. We also observed differences in gene expressions compared the control populations, supporting that AgNP and TiO2 do have toxicological impacts from chronic exposure irrespective of particle aging. TEM observations of consequent histological accumulation of the TiO2 and AgNPs supported the assumption that NPs manifest themselves as particulates. We were also able to see some recovery in the F3 generations that had their subsequent parent generations removed from exposure. The influence of biomolecules secreted by the organisms in response to the presence of NPs, and the influence of humic acid containing mixtures during the exposure phase were also investigated, providing important insights regarding the need for realistic exposure scenarios during chronic exposure scenarios.

Ecological risks under complex, multiple-stressor threat scenarios: integrating chemical effects with environmental drivers (P)
WE325 Evaluating the contribution of environmental stressors to sediment concentrations of PAHs in the northern Gulf of Mexico
I. M. Basiric, Louisiana State University; H. Rockett, R.J. Portier, Louisiana State University / Environmental Sciences
Toxicity associated with organic pollutants in aquatic sediments has not been fully characterized for the major estuarine and marine systems of coastal Louisiana. As such, five inshore and three offshore transects of the Mississippi River delta were sampled for sediment concentrations of polycyclic aromatic hydrocarbons (PAHs) and environmental variables. From 2012 to 2014, five environmental variables were measured in the northern Gulf of Mexico including: (1) percent organic matter, (2) dissolved oxygen and 3) temperature of the overlying water column, and 4) the percent sediment moisture and 5) percent organic matter of the aquatic sediment. A main effects-model was implemented in order to assess the impact of environmental variables on the concentrations of ten PAHs and three toxicity indicators in freshwater and marine sediments. A backwards, step-wise linear regression analysis of variance (ANOVA), generalized linear model (GLM) was performed to determine significant effects of measured environmental parameters. The most important environmental variables affecting the concentrations of the measured compounds were those describing the characteristics of the aquatic sediments. The percent moisture of the sediment was the most important environmental parameter, significantly affecting eight of the ten organic pollutants and all three toxicity indicators. Percent organic matter of the sediments was the second most significant parameter, accounting for the variability in concentration for five of the measured pollutants. Temperature was significant for three of the PAHs and TEQ, and in every instance it had a negative effect on concentration. Dissolved oxygen of the water column was a significant variable on the concentration a single organic compound. Water column depth and salinity did not have a significant effect on the concentration on any of the constituents. The most significant environmental variables accounting for the variability of sediment PAH concentrations, included sediment moisture and organic matter. The physicochemical properties of the overlying water column had little to no significant effect on the concentrations of the majority of the measured pollutants. This current research suggests that sediment organic matter and environmental variables affecting the concentrations of measured compounds at each sampling location should be incorporated into monitoring study design in order to more completely interpret the sediment burden of organic pollutants in aquatic sediments.

WE326 Microbial resistance to chemical pollution by urban effluents might be triggered by desiccation events.
F. Romero, S. Sabater, ICRA Catalan Institute for Water Research; O. Pereda, University of the Basque Country; l. sabater, CSIC-IDAEA / Department of Environmental Chemistry; C. Font, V. Acura, ICRA Catalan Institute for Water Research
Freshwater ecosystems are subjected to different anthropogenic pressures. Among them, wastewater treatment plant (WWTP) effluents can represent a significant proportion of total discharge, mostly in regions suffering from water scarcity. WWTP effluents contain a mixture of assimilable and toxic compounds, which concentration ultimately determines the effect of the mixture on freshwater biota. Moreover, overexploitation of water resources together with climate change are the major stressors that sediment organic matter and salinity are subjected to. In the present study we used 24 experimental channels in a replicated regressive design to evaluate how an acute desiccation event shapes the response of river microbial communities to WWTP effluents. The present study used 24 experimental channels in a replicated regressive design to evaluate how an acute desiccation event shapes the response of river microbial communities to WWTP effluents. The present study used 24 experimental channels in a replicated regressive design to evaluate how an acute desiccation event shapes the response of river microbial communities to WWTP effluents. The present study used 24 experimental channels in a replicated regressive design to evaluate how an acute desiccation event shapes the response of river microbial communities to WWTP effluents.
reduced diversity, selecting for resistant species. These resistant species could benefit from low dilution factors of wastewater effluent. Given that microbial metabolism powers biogeochemical cycling in ecosystems, we argue that functioning of freshwater ecosystems may be shaped as a result of the combined action of climate change-related stressors such as desiccation and chemical pollution.

WE327 Synergy effects of fluoxetine and variability in temperature lead to proportionally greater fitness costs: A multigenerational test

M. Oliveira, University of Aveiro; N. Inocentes, Department of Biology
CESAM, University of Aveiro / Biotic; A.M. Soares, University of Aveiro / department of Biology and CESAM; M. Barbosa, Department of Biology & CESAM - University of Aveiro / Biology

Increased variability in water temperature is predicted to impose disproportionally greater fitness costs than mean increase in temperature. Additionally, water contaminants are currently a major source of human induced stress likely to produce fitness costs. Global change models forecast an increase in these two human induced stressors. Yet, in spite of the growing interest in understanding how organisms respond to global change, the joint fitness effects of water pollution and increased variability in temperature remain unclear. Here, using a multigenerational design, we test the hypothesis that exposure to high concentrations of fluoxetine, a human medicine commonly found in freshwater systems, causes greater fitness costs when associated with increase variability in temperature. Although fitness costs were higher in the absence/ presence of Hg when each stressor were kept alone, when both stressors acted together the costs were disproportionally greater. The combined effect of fluoxetine and variability in temperature led to a reduction of 37% in lifetime reproductive success and a 17.9% decrease in population growth rate. Interestingly, fluoxetine and variability in temperature had no effect on the probability of survival. Freshwater systems are of the most imperilled ecosystems, often subjected to multiple human induced stressors. Our results indicate that organisms face greater fitness risk when exposed to multiple stressors at the same time than when each stress acts on alone. Our study highlights the importance of using a multi-generational approach to fully understand individual environmental tolerance and its responses to a global change scenario in aquatic systems.

WE328 Influence of extreme heat events in the recovery capacity of Mytilus galloprovincialis exposed to mercury contamination

C. Coppola, Department of Biology & CESAM - University of Aveiro / Biology; B.M. Henriques, CESAM - University of Aveiro and CIMAR University of Porto / Department of Chemistry; A.M. Soares, University of Aveiro / department of Biology & CESAM; R. Freitas, University of Aveiro / Departamento de Biologia CESAM; E. Figueira, University of Aveiro / Biology CESAM; M.E. Pereira, CESAM University of Aveiro / Department of Chemistry

Several studies already described the impacts caused by metals in estuarine species, including mussels, but very scarce information is available regarding their effects in a globally warming scenario. It is however, unclear how temperature can not only affect the response of organisms but their capacity to recover from pollution events. In this way, the present study aimed to understand the impact of warming in the capacity of Mytilus galloprovincialis to recover their biochemical performance after being pre-exposed to Hg. For this, mussels were exposed during 14 days at 17 °C in the absence or presence of Hg (17 °C; 17 °C Hg), after which mussels were exposed during 28 days to multiple human induced stressors. Our results indicate that organisms face greater fitness risk when exposed to multiple stressors at the same time than when each stress acts on alone. Our study highlights the importance of using a multi-generational approach to fully understand individual environmental tolerance and its responses to a global change scenario in aquatic systems.

WE329 Impacts of ocean warming and BDE-209 contamination on the energy budget of juvenile white seabream (Diplodus sargus)

P. Anacleto, Instituto Português do Mar e da Atmosfera (IPMA) / Division of Aquaculture and Seabed Upgrading; C. Figueiredo, M. Baptista, MARE - Marine and Environmental Sciences Centre; A. M. Soares, Instituto Português do Mar e da Atmosfera / Division of Aquaculture and Seabed Upgrading; C. Camacho, IPMA, LP.; M. Santos, Instituto Português do Mar e da Atmosfera / Division of Aquaculture and Seabed Upgrading; P. Pousão-Ferreira, Portuguese Institute for the Sea and Atmosphere; L. Valente, Interdisciplinary Centre of Marine and Environmental Research; A. Marques, Portuguese Institute of Sea and Atmosphere IPMA / Division of Aquaculture and Seabed Upgrading; R. Rosa, Faculdade de Ciências da Universidade de Lisboa / MARE - Marine and Environmental Sciences Centre

Climate change and chemical contamination are global environmental threats of growing concern for the scientific community and regulatory authorities. Yet, the impacts and interactions of both stressors (particularly ocean warming and emerging chemical contaminants) on the physiological responses of marine organisms remain unclear and require further research. In this context, our main goal was to study, for the first time, the effects of warming (+5 °C, i.e. 24 °C) and accumulation of a polybrominated diphenyl ether congener (BDE-209, brominated flame retardant) by dietary exposure on the energy budget of juvenile white seabream (Diplodus sargus; 3.5-2 g total body weight), used as a model. Specifically, growth (G), routine metabolism (R), excretion (faeces, F and nitrogenous losses, U) and food consumption (C) were calculated to obtain the energy budget. The results demonstrated that the energy proportion spent for growth dominated the mode of the energy allocation of juvenile white seabream (50.6-67.8%), including even under the synergistic effect of warming and BDE-209 exposure. On the other hand, energy loss via faeces was significantly higher under control temperature and BDE-209 exposure (16.0%). In all treatments, the energy channelled for metabolism was around 26% and a smaller percentage was channelled for excretion (faeces: 4.3-16.0% and ammonia: 2.3-3.3%). In general, the parameters were significantly affected by increased temperature and exposure to the flame retardant, with higher levels found under warming conditions (for wet weight, relative growth rate, protein and ash contents), BDE-209 exposure (only for O:N ratio) or under both stressors (for ammonia excretion rate and routine metabolic rate). On the other hand, lower viscoseromictic index (VSI) was observed under warming and lower fat content was observed under both stressors. Overall, with such extreme and expected conditions of warming and contamination, the energy budget of marine fish species is expected to be greatly affected, leading to impacts on fish fitness costs when associated with increase variability in temperature. Although fitness costs were higher in the absence/ presence of Hg when each stressor were kept alone, when both stressors acted together the costs were disproportionally greater. The combined effect of fluoxetine and variability in temperature led to a reduction of 37% in lifetime reproductive success and a 17.9% decrease in population growth rate. Interestingly, fluoxetine and variability in temperature had no effect on the probability of survival. Freshwater systems are of the most imperilled ecosystems, often subjected to multiple human induced stressors. Our results indicate that organisms face greater fitness risk when exposed to multiple stressors at the same time than when each stress acts on alone. Our study highlights the importance of using a multi-generational approach to fully understand individual environmental tolerance and its responses to a global change scenario in aquatic systems.

WE330 Transgenerational effects of pesticide on vector mosquito Culex pipiens under global warming

T. Tran, L. Janssens, KULeuven; K.V. Dinh, DTU Technical University of Denmark; R. Stoks, University of Leuven / Department of Biology

Recent transgenerational studies have showed that some species could acclimate to warming and pesticide separately. Transgenerational plasticity is even being considered as a powerful mechanism to enhance species resilience to projected warming. However, it is unknown how exposure to pesticide under warming in the parental generation will shape the offspring susceptibility to these stressors, specifically in vector species. We studied the transgenerational effects of single and combined exposure to warming (4°C increase) and the pesticide chlorpyrifos on life history traits and antipredator behaviors of the vector mosquito Culex pipiens using a biparental transgenerational approach. Parental exposure to warming and/or a single or combined exposure to the pesticide either warming or the pesticide, had negative effects on the offspring: both parental exposure to warming and to the pesticide resulted in an overall lower offspring survival. Parental warming impaired the anti-predator behaviors of the offspring by decreasing the diving proportion and diving time off the offspring. Within both the parental and the offspring generations, warming made the pesticide more toxic in a synergistic way. In the parental generation, the effect of pesticide were stronger at 20°C than at 24°C. In the offspring generation, this synergic effect depended on parental temperature. Pesticide induced stronger reduction in diving time at 20°C than at 24°C but only in the offspring of parents exposed to 20°C. Our results indicate that transgenerational effects will not increase the ability of this vector species to deal with pesticides in a warming world. This study highlights the importance of using bifactorial transgenerational experiment to understand the combined impact of pesticide and warming across generations, hence to assess the efficacy of vector control in a warming world.

WE331 1 + 1 ≠ 2: Heritage-dependent synergistic development responses in copepods exposed to predator cues and copper

T. Lode, DTU Aarhus University; D.J. Titelman, University of Oslo / Department of Biosciences; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Biosciences; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences

This study examines sub-lethal developmental effects of combinations of predator cues (kairomones, threespine stickleback) and copper (20 μg Cu L⁻¹) on the marine copepod Tigriopus brevitarsis. The aim was to examine effects of treatments on: 1) age at maturity; and 2) stage-dependent predation. Potential importance of pedigree was also tested by comparing offspring from different females. Individual nauplii from egg-bearing females (8 randomly picked individuals per females’ clutch) were incubated individually and exposed to one of the four treatments: control, kairomone, copper or kairomone + copper. The experiment ran for 13 days (313 hours) with daily exchange of exposure solutions and simultaneous registration of survival (activity) and development (counting shed exuviae). Food (Rhodomonas salina) was added daily ad libitum. All individuals in control were mature by the end of the experiment. A
2-parametric non-linear mixed effect model was used to describe nauplii development over time \((Instaur = K / (1 + (K - 1) \cdot e^{(-r \cdot log(m) + a + g)})\), where \(K\) is the asymptotic development stage and \(m\) is the average stage transition rate). Effects of treatment and pedregue on the two model parameters were examined by comparison of models with likelihood ratio tests and Akaike’s Information Criterion (AIC). This analysis finds that treatment influenced developmental stage at the end of the experiment, while pedregue affected the time to reach it. Developmental effects were found in the whole species but not in the development stages of surviving individuals. When all individuals in control had reached maturity (288 hours), individuals exposed to the combined treatment kainorome + copper were significantly delayed compared to all other treatments. Effects on individuals in the combined treatment were greater than expected based on the two models alone. This adverse effect on development was already evident at the time of the first emerging copepodes (138 hours). These results indicate a synergistic relationship between risk of predation and copper by increased age at maturity in developing individuals of \(T. brevicornis\). The results also show the significant role of pedregue in determining development rate. This highlights the need to consider both natural stressors and individual heterogeneity when conducting ecotoxicological studies.

WE332 Functional and structural soil-vegetation indicators of ecosystem functioning in metal-contaminated environments: a case study in SE Spain

J. Alvarez-Rodríguez, A. Peñalver Alcalá, M. Tercero Gómez, H. Conesa Alcaraz, O. Mudie and A. Álvarez-Escauriaza, Department of Biology & CESAM - University of Aveiro / Biology & CESAM Functional and structural soil parameters of six environments defined by stages of vegetation development were studied in laboratory experiments on metal contaminated soils from different environments: A) Within the mine tailings: 1. Bare soils (S); 2. Small groups of Pinus halepensis trees (2-5) ≤ 2.5 m high, growing scattered (P); 3. Isolated P. halepensis trees > 3.4 m high with shrubs and herbs under the canopy (P+MS); 4. Dense patches with several P. halepensis trees (> 3-4 m high and shrubs and herbs under the canopy (DP+MS); B) Outside the mine tailings: 5. Polluted forest with P. halepensis trees > 5 m high and shrubs and herbs under the canopy (CF); 6. Forests. Ecological indexes of vegetation were evaluated and soils analyzed for physical, chemical, and biological parameters. Soil temperature, feeding activity of invertebrates and decomposition were measured in situ. P+MS, DP+MS and PF showed the highest diversity of plant species and P the lowest. The organic C/N ratio was ≈ 20 in P+MS, DP+MS, PF and CF and ≈ 13 in S and P, which was in accordance with larger accumulation of litter in the first four environments. Cation exchange capacity (CEC), an indicator of the buffer capacity of the soil and the stability of the organic matter, was largely higher in CF (≈ 32) followed by PF (≈ 20), P+MS and DP+MS (≈ 12) and finally P and S (≈ 5). Water soluble metals and dissolved organic matter (DOM) revealed the highest concentrations of total organic C and C from microbial biomass (indicator of micro-organisms population) followed the same pattern than CEC. Total metal(oids) concentrations (mg kg⁻¹) widely varied within the tailings, without a clear pattern related with plant colonization (e.g. Pb: 5400-14600; Zn: 8600-18000; As: 200-1200). Water soluble metal(loid)s (µg g⁻¹), the most toxic fraction, were largely higher in S (e.g. Pb: 4600; Zn: 210000). Tea bag bioassay composition showed two different tendencies: DP+MS, P+MS and S had a higher weight loss than PF, CF and P. Feeding activity was (% of holes fed using: CF = 42%, P = 39%, S = 31%, PF+MS = 21%, AF = 8%; DP+MS = 7%; Total and soluble/available metals concentrations cannot be considered the only factors affecting the activity of bacteria in polluted sites, field studies including physical, chemical, and biological parameters must be considered together to obtain realistic information for understanding soil ecosystem functioning and recovering.

WE333 Effects of imidacloprid and a neonicotinoid mixture on aquatic invertebrate communities under Mediterranean conditions

A. Bischoff, A.A. Salba, L. Cherta, M. Vigh, IMDEA Water Institute; M. Vigith, IMDEA Water Institute / Earth and Environmental Sciences

Neonicotinoids are a group of insecticides that are used worldwide in agriculture to control pests in crop and aquatic ecosystems. These insecticides are considered contaminants of emerging concern due to their high toxicity to non-target aquatic organisms and their resistance to biodegradation. They are highly soluble in water to form reactive oxygen species (ROS) and form ROS in aquatic habitats. The role of ubiquitous natural organic matter (NOM) for this interaction is, however, not well understood. Therefore, this study systematically assessed the influence of ambient UV-A radiation (0.00, 0.40, 0.60, 1.00, 1.40, and 2.00 mW/cm²) and NOM (aqueous extracts of thoroughly mixed and illuminated cultures of a copper tolerant species of microalgae) on the potential of NTO (P25, 0.00 or 0.05 mg/L) to reduce the acute toxicity (96-h) of three selected pesticides (Azoxystrobin, Dimethoate, and Pirimicarb) towards the waterflea Daphnia magna. Azoxystrobin toxicity was up to 1.6-fold reduced in the presence of NTO with increasing UV intensity (0.00 vs. 2.00-2.60 W/m²). The combination of NTO and NOM enhanced the toxicity of Azoxystrobin 2-fold (0.00 vs. 1.00-1.40 W/m²). Dimethoate toxicity was 3-fold reduced with increasing UV (0.00 vs. 2.20-2.60 W/m²). NOM generally decreased the toxicity of Dimethoate by a factor of ~3, whereas the combination of NTO and NOM revealed the highest toxicity reduction with increasing UV (4-fold, 0.00 vs. 2.20-2.60 W/m²). The
toxicity of Primicarb was reduced 1.7-fold with increasing UV (0.00 vs. 2.20-2.60 W/m²). In presence of NOM, Primicarb toxicity was generally decreased (up to 2.3-fold, e.g. 0.00 W UV/m²). Depending on pesticide type and factor combinations we observed both positive and negative effects of UV radiation on the toxicity of the selected pesticides. A general prediction on the combined effects of nTiO₂, NOM, and UV on the toxicity of pesticides seems currently difficult. Rather, physiological properties like pesticide structure, solubility, adsorption, and degradation seem to be crucial for the interaction with nTiO₂, NOM, and UV-A, and the ultimate pesticide toxicity.

**WE336**

Effects of inorganic sunscreen formulations on the algal symbionts of reef-building corals, Symbiodinium spp., and their combined toxicity with ocean warming.

A. Tagliati, Heriot Watt University / Institute of Life and Earth Sciences; S.J. Hennige, The University of Edinburgh / School of Geosciences; T.F. Fernandes, Heriot-Watt University / Institute of Life and Earth Sciences

Between 4,000 and 6,000 tons of sunscreens annually are washed from the skin by swimming, sunbathing, and direct release into the waters, posing a potential threat to coral reef ecosystems. Titanium dioxide nanoparticles (nTiO₂) are common UV filters in cosmetic products, and in typical sunscreen formulations they are dispersed in an oil phase, a mixture of emulsifiers and emollients which can reach up to 20% of the product content by weight. In order to assess the impact of inorganic sunscreen on corals’ endosymbiotic algae (Symbiodinium spp.), three nTiO₂ with different sizes and surface coatings were dispersed in an oil phase to mimic commercial available sunscreen formulations. Two Symbiodinium phylotypes, known for their different tolerance to environmental change and stress, were exposed to oil:nTiO₂ dispersions at both ambient temperature (26°C) and thermal stress condition (32°C). Growth rates, maximum photosynthetic activity and reactive oxygen species (ROS) production were evaluated. Symbiodinium spp. exposed to sunscreen dispersions showed negative effects on all endpoints studied, and the toxicity is enhanced with simultaneous heat stress. Results indicate toxicity is not dependent on the type of nanoparticle and it is likely driven by the oil carrier, a major ingredient in all cosmetic sunscreens. Released oil, and the nanoparticles in the oil droplets, accumulate in the water surface microlayer and sediments due to its lipophilic characteristics and resistance against decay, constituting a major risk to marine organisms. Corals rely on the photosynthetic provided by the endosymbiotic algae for their nutrition, and the production of excess ROS by Symbiodinium cells as a consequence of heat stress, is considered to be a trigger of coral bleaching (the loss of Symbiodinium from the coral host). The significant decrease of maximum photosynthetic activity at 32°C coupled with the algae growth rate decline, and direct release of toxic free waters,posing a potential threat to coral reef ecosystems. The increased ROS production following sunscreen exposure, in addition to the reduction of photosynthetic activity, provide evidence that exposure to these types of sunscreens may exacerbate bleaching response in corals and pose a risk to coral reef ecosystems in a changing ocean.

**WE337**

Metallothioneins as an indicator of metal exposure in a naturally mineral enriched aquatic environment

H. Pienaar, C. Wolmarans, G. Van Niekerk, NorthWest University School of Biological Sciences / Zoology; V. Wepener, North-West University - School of Biological Sciences / School of Biological Sciences

The Marico River, in the North West province of South Africa, is relatively unaffected by anthropogenic activities. However, metal concentrations – mainly from natural sources – occasionally exceed environmental quality guidelines or toxic concentrations. Macroinvertebrates are capable to react to these metals through processes such as the induction of metallothioneins (MTs). The aims of this study were to determine whether the induction of MTs can be used as indicator of natural metal exposure in anthropogenically impacted systems and whether there are relationships between metal concentrations in water, sediment and macroinvertebrates and concomitant MT levels. This was done by sampling macroinvertebrates, water and sediment from eight sites in the Marico River and tributaries. Water and sediment samples were prepared and analysed with an ICP for the determination of metal concentrations. Seven families including Notonectidae, Coenagrionidae, Atyidae, Libellulidae, Baetidae, Caenidae and Chironomidae were selected and digested for metal analyses. Four families including Gerridae, Aeshnidae, Atyidae and Coenagrionidae were also analysed to determine their MT concentration. To test for possible relationships between metal concentrations in the macroinvertebrate families, MTs and metal concentrations in the water and sediment, Spearman’s non-parametric correlation tests were done among sites. Positive correlations were found between metal in sediment and macroinvertebrates, while there were no correlations between metal concentrations in water and macroinvertebrates. Even in freshwater river systems with a relatively low human impact and no mining activities, a positive correlation existed between trace metal bioaccumulation (e.g. Ni, Pb, Zn) in macroinvertebrates and the induction of MTs. There were, however, no correlations between MTs and bioaccumulation of earth metals (e.g. Al, Fe, Mn, Ti). These data clearly demonstrate the application value of MTs as biomarkers for metal exposure in freshwater systems.

**WE338**

Mollusks as indicators of environmental pollution (case studies in marine mussel Mytilus galloprovincialis Lam. and terrestrial snail Bradybaena fruticum Mull.)

T. Kuznetsova, Saint-Petersburg Scientific Research Center for Ecological Safety Russian Academy of Sciences / Lab Bioelectronic Methods for Geoecological Monitoring; S. Khokhlevich, Saint-Petersburg Scientific Research Center for Ecological Safety, V.M. Makeeva, Earth science Museum of Lomonosov Moscow State University; N.N. Kamardin, Saint-Petersburg Scientific Research Center for Ecological Safety Russian Academy of Sciences; A.V. Smurov, Earth science Museum of Lomonosov Moscow State University

Snails are widely used as sentinel species in marine and terrestrial biomonitoring. Their widespread distribution in different biotopes, high sensitivity to pollution makes them good bioindicators in environmental quality assessment. The comparability of mollusks in pure and polluted sites was performed in field studies round Moscow Region and in Moscow city as well as for marine biocindication in a few locations round Sevastopol city. Cardiac activity registration in selected mollusks was carried out as a tool for measuring deterioration of general health of local biota in the sites of the concern. Methodology with standard testing of heart rate (HR) and HR variability using functional loads (short-term temperature, salinity change, some mechanical stimuli, etc.) were carried out. In land biodiagnostics a 3-4 years old genetically modified morphs of bush snails Bradybaena fruticum (Mull.) were used collected from Moscow city (Kartmazovo, Kuz/minky,Ismailov Park) with respectively 0.03 and 0.08 ng/L of eutrophen levels of metal concentrations. Pair comparison was done based on cardiac activity monitoring in mentioned groups of snails under thermal treatment (20-50min, 50(±5)ºC). It was revealed that snails of the same genotype (striped and without strips) from chemically polluted sites (Kartmazovo, Kuz/minky) differed in low thermosteresis from those of the reference side and Ismailovsky Park demonstrated in dynamics of HRs. The higher thermal resistance of Mytilus galloprovincialis Lam. was performed in Sevastopol Bays using salinity change test. Possible links between chemical pollution by dioxin (in terrestrial snails) and heavy metals contents in mollusk’s tissues (in marine mussels) and peculiarities of HR recovery after thermal or salinity loads were discussed.

**WE339**

The effect of temperature on toxicity of cypermethrin on Daphnia magna

P.T. Kajankari, University of Helsinki / Department of Environmental Sciences; V. Juutila, University of Helsinki; A. Rantalainen, University of Helsinki; O. Penttinen, University of Helsinki / Faculty of Biological and Environmental Sciences

Cypermethrin is an insecticide which European Parliament of the Council has classified as a priority substance in Directive 2013/39/EU in the field of Water Policy. The Annex II of the Water Policy sets the environmental quality standards (EQS) for the priority substances. Cypermethrin’s annual average and maximum allowable concentration in inland surface waters are 0.08 ng/L and 0.6 ng/L respectively and annual average and maximum allowable concentrations in environmental quality standard. The abiotic stressor like the temperature can have an effect on toxicity of the chemical. Previous studies have shown that the temperature of the environment affect the toxicity of pesticides belonging to the pyrethroids which cypermethrin is part of. The 48 hour half maximal concentration (EC50) and median effective time (ET50) values were tested with crustacean Daphnia magna immobilization at the temperatures 10 ºC, 16 ºC and 20 ºC in laboratory experiments. Cypermethrin was almost twice as toxic at 10 ºC (2.17 ± 0.20 µg/L) compared with 20 ºC (4.10 ± 0.30 µg/L). The EC50 value of 16 ºC was 2.64 ± 0.21 µg/L which was closer to EC50 value of 10 ºC than 20 ºC. The temperature had statistically significant effect in the EC50 experiment. The temperature did have a slight effect in the ET50 experiment. The ET50 value at 10 ºC was 30.60 ± 0.74 hours compared with 33.12 ± 0.79 and 32.86 ± 0.83 hours respectively at 16 ºC and 20 ºC. The only statistically significant difference between the temperatures was between 10 ºC and 16 ºC. The temperature dependent behavior of cypermethrin was not taken into account when the environmental quality standard for cypermethrin was set by European Union and the United States Environmental protection agency’s reregistration eligibility decision for cypermethrin. With pyrethroids deltamethrin and permethrin the Canadian guidelines do not take account effects of temperature. When guidelines and legislations are prepared to certain chemicals some abiotic factors like the temperature should be considered. Key to changing guidelines and legislation is to take account the possible effects of temperature in test standards.

**WE340**

Pattern oriented food web modelling of metal mesocosm datasets

K. Vrjane, Ghent University / GheToxLab; F. De Laender, Universiteit de Namur ASBL / Research Unit in Environmental and Evolutionary Ecology; K. De Schamphelee, Ghent University (UGent) / Applied Ecology and Environmental Biology; F. Van Assche, IZA; S. Bruneau, European Copper Institute; P. Van Sprang, ARCHE

The risk assessment of metals has a long history and over time a large collection of
ecotoxicity data has been accumulated. The most informative tests performed for the ecological effects of toxicants are mesocosm studies: controlled experiments where the effects of toxicants on model communities are studied for extended periods of time. Mesocosm studies are cost- and labor-intensive but offer a unique insight into realistic ecological effects of toxicants: they address not only direct effects on sensitive species, but also indirect effects resulting from ecological interactions (e.g. competition, predation) between sensitive and less sensitive species. Typically, the effects occurring in mesocosm studies are however complex and difficult to interpret. A study has been set up to investigate whether food web modelling can reveal additional patterns, trends, or interactions in existing copper and zinc mesocosm datasets. Pattern oriented food web modelling – an ecological modelling technique – is used to reveal the mechanisms underlying metal effects. With this approach, multiple, deterministic patterns in the datasets will be identified and described. Models are then evaluated for their ability to reproduce these patterns. In the case of mesocosm studies, food web models can be applied to understand the mechanism behind observed patterns. A large diversity of food web models exists with large differences in their complexity and underlying theories. Food web models based on ordinary differential equations are relatively simple in structure while they can still account for the interactions between species in the food web. They are therefore ideally suited to study mesocosm data. Additionally, the effects of environmental parameters such as temperature and pH, often key determinants of metal toxicity, can be included. Finally, the potential Pathway of Effects – explaining how metal toxicity leads to the observed patterns – can be evaluated to identify the most important drivers of metal toxicity in the mesocosm food webs and derive community-based threshold levels.

**WE341 Bioaccumulation and physiological conditions in Ruditapes philippinarum from the Vallona lagoon (northern Adriatic Sea, NE Italy): Application of Biomonitoring Methods**

E. Castiglione, ISPR-A Institute for Environmental Protection and Research / Mitigation and Prevention of Impacts; V. Bernarelli, R. Boscolo Brusà, G. Franchescini, G. Sesta, C. Maggi, D. Berto, M. Gabellini, C. Virino Lambertini, ISPR-A Institute for Environmental Protection and Research

*Ruditapes philippinarum* (Adams & Reeve, 1850)is a soft-bottom dweller bivalve commonly used in biomonitoring programs, especially in bioaccumulation assessment, owing to its high tolerance to toxic compounds. However, bioavailability and accumulation of contaminants in the soft tissue of mussels could be affected by abiotic factors, such as food availability, pH and temperature, and also by biotic factors, such as the seasonal changes of flesh weight in mussels. In this context, some issues could arise especially when comparing different sites in a study while they can still account for the interactions between species in the food web. They are therefore ideally suited to study mesocosm data. Additionally, the effects of environmental parameters such as temperature and pH, often key determinants of metal toxicity, can be included. Finally, the potential Pathway of Effects – explaining how metal toxicity leads to the observed patterns – can be evaluated to identify the most important drivers of metal toxicity in the mesocosm food webs and derive community-based threshold levels.

**WE342 Biomonitoring of Singapore mangroves using biomarker expression and contaminant burden in caged green mussels, Perna viridis**

G. Bayen, McGill University / Singapore-Delft Water Alliance; E. Segovia, C. Goh, W. Lee, National University of Singapore; B.C. Kelly, National University of Singapore / Civil & Environmental Engineering

Mangroves are fragile coastal ecosystems whose ecological and socioeconomic importance for adjacent ecosystems and local populations is being clearly recognized nowadays. Mangroves are one of the most threatened tropical environments and our understanding of the impact of chemical pollution on these ecosystems is still at its infancy. In this study, nine mangroves sites were selected around Singapore coastline to cover various contamination profiles, and green mussels, *Perna viridis* were used as bioindicators. Bivalves were deployed in cages at each of the nine mangrove patches for 28 days on two consecutive years (one year during the monsoon period and the other year during a dry-weather period), and collected for subsequent analysis. A series of biochemical and cellular biomarkers were developed and measured using various organs. Metallothioneins (MTs), Glutathione-S-Transferase (GST), Ethoxyresorufin-O-deethylase activity (EROD), Vitamin-like protein (VLP), Acetylated glutathione transferase (AChE) were measured in the bivalves’ soft tissues. Mussel’s haemolymph was also used to evaluate various physiological parameters (Total Haemocyte counts, phagocytosis and lysozyme levels) and the level of haemocytes’ DNA damage, using the Comet assay. Results of this study revealed different patterns of biomarker expression which vary between the various sites. Most notably, metallothionein induction was seen in some sites, while others indicated potential exposure to heavy metals while also showing higher levels of DNA damage and EROD in some of the mangrove patches pointing towards possible exposure to organic contaminants. Some biomarkers appeared to be subject to seasonal variations while others were very stable. Possible correlation between biomarker expression and the level of contaminants (metals, PAs, pharmaceuticals, endocrine disruptive chemicals, personal care products) in caged mussels was studied. Using an Integrated Biomarker response index, the various mangrove sites were eventually ranked amongst each other. Our findings ultimately indicated a clear segregation of mangrove sites, indicating that some mangrove patches were potentially more at risk than others towards chemical contamination.

**WE343 Impacts of climate change on mercury bioaccumulation in large ocean predators**

E.M. Sunderland, Harvard University / School of Engineering and Applied Sciences; A.T. Schartup, Harvard T.H. Chan School of Public Health / Department of Environmental Health; C. Thackray, Harvard University / School of Engineering and Applied Sciences; A. Castano, IIT Hyderabad / Civil Engineering; C. Dassuncao, Harvard University

Many marine ecosystems are being affected by climate driven changes in freshwater discharge, circulation, productivity and seawater temperature. Large ocean predators such as tuna account for a large proportion of methylmercury exposure in many countries (almost 40% of U.S. population wide intake between 2010-2012). Methylmercury is a potent neurotoxicant, particularly for children, and has been associated with impaired cardiovascular health in adults. We have developed a new mechanistic model for methylmercury bioaccumulation in marine food webs (MAM). The model is driven by methylmercury concentrations in seawater and ocean biogeochemical conditions (temperature, dissolved organic carbon, DOC and trophic status). Here we apply this model to investigate the magnitude of changes in methylmercury concentrations expected from decadal oscillations in seawater temperature in the North Atlantic. We compare the magnitude of these changes to those occurring in the Pacific Ocean and discuss how climate related variability is likely to affects exposures of humans and wildlife to methylmercury. Our results suggest changes in tissue burdens driven by oscillations in seawater temperature are similar in magnitude to those that have been achieved by reductions in emissions in the North Atlantic.

**WE344 Chemical stress on aquatic communities under semi-arid conditions: towards an improved multimetric approach**


Combined effects of chemical pollution and water scarcity are one of the most important threats to aquatic ecosystems in (semi-)arid regions of the world. The low dilution potential of chemicals (urban, industrial and agricultural) discharged in aquatic ecosystems under water scarcity conditions could lead to devastating toxic effects. Moreover, a large proportion of aquatic bodies in these regions are known to have a high hydrological variability in a temporal scale. In this sense, communities naturally adapted to this condition are expected to respond differently to a chemical stress than those adapted to more constant water flows. The aim of this study was to evaluate the combined effects of multiple stressors on aquatic ecosystems in scenarios that are characteristic of (semi-)arid regions. In particular, this study focused on identifying the main stress factors that are influencing aquatic communities in the semi-arid region of Madrid (central Spain). Sixteen sites were selected in the watershed of the Tagus River (Madrid, Spain) and sampled in three different periods (spring, summer and fall). Hydrological and physico-chemical parameters of aquatic ecosystems were monitored, together with concentrations of metals and organic contaminants (pharmaceuticals, home-care products, pesticides). With respect to organic contaminants, the results from a screening analysis revealed the presence, at detectable levels, of 100 compounds in water samples. A group of 42 contaminants were selected for quantification due to their high toxic potential to aquatic organisms and frequent detection. Complex mixtures of pharmaceuticals, as well as highly toxic pesticides were identified. Through a multivariate analysis including pollution data, flow variability and related physico-chemical parameters, the main stressors and possible differences at
a temporal and spatial scale were evaluated at a taxonomic and at a biological trait level. Significant responses to multiple stressors from some invertebrate taxa and functional traits (feeding habits, reproduction and respiration) were determined. Based on these results, suggestions for a biological vulnerability multimetric index, which considers more site-specific conditions, will be presented.

**WE345**

**Long-term effects on transplanted caged-freshwater bivalves**

**Diplopod chilensis** to the assessment of water quality in a Patagonian river

M.S. Yusseppone, Facultad de Ciencias Exactas y Naturales Universidad de Buenos Aires / Department of Biochemistry, IQUIBICEN-CONICET; FCEN-UBA; S.E. Sabatini, IQUIBICEN CONICET Universidad de Buenos Aires / Department of Biochemistry; A. Blanco, Instituto de Investigaciones Caracterización de Nuequén / INIBIOMA-CONICET; C.M. Luquet, CONICET / Laboratorio de Ecotoxicología Acuática INIBIOMA; C.M. Luquet, CONICET / Laboratorio de Aquatic Ecotoxicology, INIBIOMA; I. Rocchetta, IQUIBICEN CONICET Universidad de Buenos Aires / Department of Chemistry Biochemistry; M.d. Riis de Molina, Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales / Departamento de Química Biológica, CONICET-UBA, Instituto de Química Biológica - Ciencias Exactas y Naturales (IQUIBICEN)

Population growth and human activity are contributing to habitat deterioration in Patagonian rivers with the consequent threat to water quality and biodiversity. The bivalve Diplopod chilensis is a key species in the macroinvertebrate fauna of Patagonian lakes and rivers which has been proposed as a sentinel organism in the area. We evaluated the long-term effects of transplantation of caged D. chilensis to different sites in the Chimehuin river (reference site (S1)), downstream from an aquaculture facility (S2), and from an open dump and from the sewage treatment plant (S3) after 3, 6, 9 and 12 months of exposure. We combined the antioxidant response, oxidative damage, ROS production and energy status, with water chemistry and sediment analysis (physico-chemical and biological variables, and organic matter content). Physico-chemical variables varied according to site and time of exposure. Sites S2 and S3 showed generally higher chlorophyll a concentration and total coliform bacteria values compared to site S1, whereas organic matter content in the sediment was elevated only at site S2. In D. chilensis, sild SOD and GST activity was higher in both S2 and S3 than in S1 by the end of the exposure time. During the last month of exposure (month 12), GSH levels dropped dramatically and lipid peroxidation levels increased in individuals from S2 and S3 sites. Digestive gland factor (DFG) and energy values in digestive gland were increased at sites S2 and S3, from 6 to 9 months of exposure. Our results indicate that despite the large flow rate of Chimehuin river water quality is deteriorated in areas impacted by anthropogenic activities (aquaculture, solid waste, sewage treatment, and sewage). This effect is reflected by a physiological response of D. chilensis, which is especially significant during period of their highest metabolic activity (autumn fall/ winter).

**WE346**

**The influence of selected seasonal and anthropogenic phenomena on a perennial river in South Africa.**

G. Van Niekerk, North West University (Potchefstroom Campus) / Zoology-School of Biological Sciences; C. Wolmarans, H. Pienaar, North-West University - School of Biological Sciences / Zoology

The quality of surface waters worldwide is declining fast. This is due to anthropogenic activities, such as urbanization and natural occurring floods and droughts which are predominant abiotic agents of disturbance in intermittent streams. The objective of this study was to establish whether seasonal fluctuations can reduce the effect of anthropogenic impacts on the river and whether this is reflected by macroinvertebrate assemblages, physico-chemical water parameters and metal concentrations in the water and sediment. Water quality and macroinvertebrate community data were collected in the Crocodile River (South Africa). Four surveys were conducted, two during the low-flow and two during the high-flow season. Spatial and temporal variations were found with regard to suspended solids and total organic material. The low flow surveys had a slight increase in suspended solids and total organic material, whereas a substantial increase during the high-flow season was found with regard to suspended solids and total organic material. In the high-flow season, the highest concentrations of metals in the water column were in contrast to the sediment concentrations observed during the high-flow seasons at the majority of the sites. Only minor differences in sediment metal concentrations were noted between high and low flow seasons. The pH values increased from the origin of the river downstream. However this did not result in a clear trend with regard to either an increase in sediment metals or a decrease in the concentration of dissolved metals. A combination of biological indices (Taxa Richness, Shannon-Wiener diversity index and Pielou’s evenness index) were calculated for each site and season, and no significant differences were found between the high and low flow seasons for any of the indices at each of the sites (P > 0.05). The highest percentage of families at all the sites and seasons were classified as highly tolerant and tolerant to organic enrichment. It can be concluded that the high flow seasons (associated with rain and floods) did not have a rejuvenating effect on the river, as mentioned in previous studies. This phenomenon is substantiated by the metals concentrations, total organic matter, total suspended solids, electrical conductivity and the fact that all the taxa collected in large numbers during both seasons were tolerant to highly tolerant.

**WF347**

**Photosynthetic and Antioxidative Defense System Response of Hordeum vulgare to Combined Stress of Heat and Drought**

A. Diskaityte, Vytavus Magnus University; R. Dagliutė, Vytavus Magnus University / Environmental Science Department; L. Küblé, D. Miskelytė, G. Juozapaitienė, Vytavus Magnus University

Extreme climatic events such as heat waves and drought periods are predicted to increase in frequency and severity in many regions under future climate scenarios, and in natural environment these two abiotic stresses often occur simultaneously. The short-term (3 day-long) impact of +10 °C heat wave treatment 6.5 h per day was investigated on Hordeum vulgare under well-watered and water deficit conditions in Closed-top chambers under controlled environment. The decreases in shoots dry weight, shoots length and leaves area were observed in the water deficit treatment after exposure to heat wave, while all these parameters in the well-watered treatment were not affected significantly. The decline in photosynthetic growth under water deficit conditions was most likely caused by a considerably greater reduction in photosynthetic rate as well as far stronger oxidative stress caused by combined impact of heat wave and drought than that from single heat wave treatment as revealed by higher level of malondialdehide content and considerably stronger stimulation of antioxidative enzymes. Full recovery of photosynthetic processes and water deficit treatment after one day regeneration period. In contrast, neither shoots dry weight nor leaves area as well as most physiological processes analyzed, membrane damage, and catalase activity in water deficit treatment were not recovered to the control value. The obtained results showed that drought-stressed Hordeum vulgare plants suffered markedly stronger physiological and oxidative stress caused by drought compared to water deficit treatment. Our results revealed an importance of soil water availability even during the short-term heat wave period. Keywords: Hordeum vulgare, heat wave, drought stress, antioxidant system, photosynthesis, growth

**WF348**

**Does elevated CO2 protects plants against heat waves damage?**

J. Zaltauskaite, Vytavus Magnus University / Department of Environmental Sciences; G. Sujetoviene, I. Januskaitiene, A. Diskaityte, D. Miškelytė, G. Juozapaitienė, R. Juknys, Vytavus Magnus University

The frequency and severity of heat waves is increasing as a result of climate change. Thermal stress events may result in decreases in growth and productivity, and in natural environment these two abiotic stresses often occur simultaneously. The decline in photosynthetic growth under water deficit conditions was most likely caused by a considerably greater reduction in photosynthetic rate as well as far stronger oxidative stress caused by combined impact of heat wave and drought than that from single heat wave treatment as revealed by higher level of malondialdehide content and considerably stronger stimulation of antioxidative enzymes. Full recovery of photosynthetic processes and water deficit treatment after one day regeneration period. In contrast, neither shoots dry weight nor leaves area as well as most physiological processes analyzed, membrane damage, and catalase activity in water deficit treatment were not recovered to the control value. The obtained results showed that drought-stressed Hordeum vulgare plants suffered markedly stronger physiological and oxidative stress caused by drought compared to water deficit treatment. Our results revealed an importance of soil water availability even during the short-term heat wave period. Keywords: Hordeum vulgare, heat wave, drought stress, antioxidant system, photosynthesis, growth

**WF349**

**Combined effects of increased temperatures, drought and an insecticide on freshwater zooplankton communities**: a microcosm study

A.A. Sanchez, IMDEA Water Institute / Aquatic Ecotoxicology; I. López, L. Nozal, IMDEA Water Institute; M. Vigil, IMDEA Water Institute / Earth and Environmental Sciences; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology Water scarcity and chemical pollution are two of the main groups of stressors causing ecological impairment in freshwater aquatic ecosystems of (semi-)arid regions. Predictions about human and climate pressure on water resources in these regions reveal that the interaction between these two groups of stressors will increase in the nearby future. In line with that, advances in ecological risk assessment recognise that stress factors harming aquatic ecosystems rarely operate individually. Therefore, new approaches to assess interactions between multiple stressors are needed. In this study we evaluated the combined effects of the insecticide lufenuron and two additional stress factors: increasing water temperatures and droughts. Twenty-seven microcosms were stocked with pond water, sediment, and a homogeneous plankton assemblage. Three environmental scenarios were simulated: 20°C and 28°C without desiccation, and 28°C with desiccation. The experiment was performed in triplicate with three insecticide concentrations (Control, Low, and High Concentration) in each environmental scenario. The insecticide was applied twice, with a 10 day interval between applications. Test units without desiccation were refilled twice per week with distilled water. Test units exposed to drought stress were not refilled and allowed to desiccate. After that, these units were refilled up to the initial level and maintained for two more weeks. Lufenuron concentrations in water and sediments were periodically measured, together with water quality parameters (DO, pH, T, EC and nutrients). Zooplankton composition was determined on a weekly basis, and the isolated and interactive effects of temperature, drought and lufenuron were evaluated using suitable statistic techniques. Effects were assessed at the community and at the
population level. Lufenuron was the main stressor in all the environmental scenarios, with a significant decrease of Cladocera and copepods, and an increase of Rotifera. Temperature and drought had slight effects on community composition and accelerated insecticide dissipation, influencing community recovery capacity. Interaction between factors at community and population level was mainly observed at the beginning of the experiment. Direct and indirect responses at population level varied between environmental scenarios. The results of this study contribute to understand differences in vulnerability of aquatic ecosystems to multiple stressors in (semi-)arid regions.

**WE350**

Toxicity of phenoxy herbicide: the effects of elevated temperature and CO2 concentration

J. Zaltasaktis, Vytautas Magnus University / Department of Environmental Sciences; G. Sjövede, F. Dikaios, J. Januskaitiene, G. Kaciene, G. Juozapaitiene, D. Miskelyt, Vytautas Magnus University; S. Sakalauskien, J. Miliuskien, Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry; R. Juknas, Vytautas Magnus University

Climate change is a major concern for agriculture. Sugar cane crop productivity. Crop productivity strongly depends on crop protection measures such as use of herbicides. Climate change will influence the fate and ecotoxicity of herbicides by altering their environmental partitioning and degradation, distribution and abundance of weeds and growth and development of weeds and crops. Different responses of crops and weeds to elevated temperature and CO2 may also cause shifts in the co-evolution of the interactions. The aim of the study was to examine the influence of elevated temperature and CO2 on the effects of phenoxy herbicide to spring barley (Hordeum vulgare L.) and common lambsquarters (Chenopodium album L.). Two climate scenarios were investigated: current climate (21 °C, 400 ppm CO2) and future climate (25 °C, 800 ppm CO2). The terrestrial target Ch. album and non-target H. vulgare plants, growing together in the microcosms in a combination 2:1, were sprayed with herbicide sprays solutions equivalent to 0.5-2 of field application rate. The plants were sprayed at the four- to five-leaf stage with herbicide solutions prepared with 4-Chloro-2-methylphenoxyacetic acid (MCPA, CAS No. 94-74-6, Sigma-Aldrich). The growth and reaction of antioxidative defence system of both species were evaluated.

**WE351**

Combined effects of insecticide exposure and predation risk on freshwater detritivores

A. Rodrigues, University of Aveiro / Biology Department and CESAM; M.D. Bordu, University of Aveiro; O. Golovko, O. Koba, University of South Bohemia in Ceske Budejovice; N. Rizzuto, Norwegian Agricultural Centre of Aquaculture and Biodiversity of Hydrogenoses; C. Barata, CSIC / Environmental Chemistry; A.M. Soares, University of Aveiro / department of Biology & CESAM; J. Pestana, CESAM & University of Aveiro / Biology

Exposure to sub-lethal concentrations of insecticides are known to pose at risk non-target insects due to effects on physiology and behaviour. Under natural conditions, there may be a trade-off between reducing the risks to natural stessors, such as predation. Perception of predation risk alone may change the behaviour and physiology of prey species, impacting their fitness and, thus, their susceptibility to chemical exposure. There are thus growing efforts to understand how the combined effects of toxicants and biotic stressors may affect populations, food web dynamics and ecosystem functioning. Chlorantraniliprole (C. riparius) and deltamethrin (D. p. l.) were selected as model compounds because of their specificity for insect ryanodine receptors of target species. So, to assess the combined effects of insecticide exposure under predation risk on freshwater detritivores we studied the behavioural and developmental responses of Chironomus riparius. Plus, we tested whether the responses of the C. riparius, a collector, would change in the presence of a shredder species and the associated production of fine particulate organic matter (FPOM). For that, trials were performed using a simplified trophic chain: Anas platyrhynchos as food resource, the shredder Sericostoma vitatum, the collector C. riparius and their natural predator the dragonfly Cordulegaster boltonii. A full factorial design tested the effects of the CAP (0 or 2 µg/L), presence/absence of the predator C. boltonii and of the herbicide C. riparius loss (0 or 1). The results showed that exposure to an environmentally relevant concentration of CAP decreased leaf decomposition in all treatments. Predation risk marginally reduced shredder effects on leaf decomposition. Considering detritivores interaction, an interspecific competition is suggested since the presence of shredders impaired chironomids growth. Results show that CAP exposure, predation risk and shredder presence) and a marginal interaction between CAP and predation risk was also observed. To conclude, this study highlights the need to consider natural biotic stressors and species interactions in risk assessment of chemical pollution, since both vertical and horizontal diversity play their role on response to stress.

**WE352**

How sugarcane and high temperatures are contributing to amphibian declines in Brazil? Morphological, biochemical and molecular approaches

J. Freitas, University of Sao Paulo - USP / Department of Hydraulic and Sanitation;

E.A. de Almeida, Fundação Universidade Regional de Blumenau; D. Schlenc, University of California-Riverside / Department of Environmental Sciences; E. Espindola, University of Sao Paulo USP / Hydraulics and Sanitation

Sugarcane is the most efficient first-generation source of ethanol in the market, which has contributed to the rapid expansion of its crops and generated concerns related to its environmental impacts to Brazilian territory. In tropical areas, agricultural activities of sugarcane are intensified during the rainy season, which coincides with the period of occurrence of several amphibian species. Tadpoles and other aquatic animals from tropical areas of the world also experience large temperature fluctuations in their habitats. So, there is a great concern that amphibians are not only being affected by pesticides in their environments, but also by the combined effects of pesticides and temperature changes. In this study, we evaluated biochemical, morphological and molecular effects caused by the exposure to herbicides used on sugarcane crops in Brazil (diuron and its metabolite, 3,4-DCA, clomazone and sulfonylurea) on tadpoles of different species, using different thermal gradients. Our results showed that temperature is an important factor influencing the toxicity of pesticides in tadpoles. Diuron combined to higher temperatures accelerated metamorphosis process in tadpoles of Lithobates catesbeianus. Temperature levels and herbicides exposure (dio2, dio3, thy, tra, trb and klf9) were mostly upregulated in these groups, showing disrupt effects of diuron for amphibians. 3,4-DCA presented similar responses to diuron on L. catesbeianus and its effects were also pronounced at high temperatures. Native tadpoles of Rhinella schneideri and Euphengis nattereri had their antioxidant defense system affected by exposure to the herbicides clomazone and sulfonylurea, respectively. Sulfate had a modulatory effect on diuron antioxidant enzymes, as CAT, G6PDH and biotransformation enzymes activities and induced lipid peroxidation with temperature associated responses in tadpoles of both species. Clomazone also increase carboxylesterase activities in tadpoles exposed at higher temperatures. Integrated Biomarker responses (IBR) index showed a synergetic effect of temperature and sulfonylurea or clomazone in R. schneideri and E. nattereri. Our results indicate that the effects of herbicides on tadpoles, and its effects can be pronounced at higher temperatures. These findings imply that the effects of abiotic factors should be taken into account to evaluate the real risks of exposure of amphibians to commonly used pesticides, mainly in tropical areas.

**WE353**

Adaptation vs. acclimation of natural phytoplankton communities towards herbicide exposure

S. Rizzuto, Lancaster University / Lancaster Environment Centre; D. Bah, NIVA Norwegian Institute for Water Research; K.C. Jones, Lancaster University / Lancaster Environment Centre; E. Leu, Akvaplan-niva AS; L. Nizzetto, NIVA

Freshwater ecosystems are subject to natural and anthropogenic disturbances such as climate change, landscape management, natural resources overexploitation and also pollution. Chronic background contamination by pesticides applied in agriculture poses a selective pressure on natural phytoplankton communities, favouring species and strains that can handle herbicide exposure better than others. However, it will not adapt to future environmental changes as climate change, landscape management, natural resources overexploitation and also pollution. Chronic background contamination by pesticides applied in agriculture poses a selective pressure on natural phytoplankton communities, favouring species and strains that can handle herbicide exposure better than others. However, it will not adapt to future environmental changes. By this reason, phytoplankton communities exhibit an acute response to herbicides exposure (isoctrotron, nominal concentration – 12 µL/L) in phase 1. Afterwards (Phase 2), we subjected the resulting communities to a stressor experiment where we applied 4 different concentrations of the same herbicide (deltamethrin, ortho-isonicotinic acid), using FAME, a software tool to evaluate the response of freshwater communities to stress experiment where we applied 4 different concentrations of the same herbicide (deltamethrin, ortho-isonicotinic acid), using FAME, a software tool to evaluate the response of freshwater communities to stressor exposure during germination. The results of this study suggest that the community resulting from the exposure to the stressors is not uniformly well optimized to utilize available resources in the best possible way. The hypothesis behind this study is drawn from the following concept: The history of community exposure to chemical pollution in the environment influences the sensitivity of responses to contemporary stressors. This may persist for a variable amount of time, depending on whether it is determined by purely ecological or evolutionary processes and on the ability of the ecosystem of recruiting diversity and the structure necessary to cope with new environmental conditions. In order to assess these hypotheses we have studied the effect of long-term adaptation vs. acclimation in a two phase community level experiment with natural phytoplankton communities from a pristine and an agricultural catchment. Using a controlled experimental setup, phytoplankton communities were germinated from sediments with and without herbicide exposure (isocrotron, nominal concentration – 12 µL/L) in phase 1. Afterwards (Phase 2), we subjected the resulting communities to a stressor experiment where we applied 4 different concentrations of the same herbicide (deltamethrin, ortho-isonicotinic acid), using FAME, a software tool to evaluate the response of freshwater communities to a stressor experiment where we applied 4 different concentrations of the same herbicide (deltamethrin, ortho-isonicotinic acid), using FAME, a software tool to evaluate the response of freshwater communities to stressor exposure during germination (Phase I).

**WE354**

Impacts of climate change on freshwater pesticide exposure

T. Sinclair, University of Sheffield / Animal and Plant Sciences; A. Boxall, University of York / Environment Department; L. Maltby, The University of Sheffield / Dpt. of Animal & Plant Sciences; S. Beulke, Envisearch / Food and Environmental Safety Programme; R. Williams, Centre for Ecology & Hydrology

Climate change will modify environmental conditions which will likely have knock-on effects on the usage and environmental fate and behaviour of active
pesticide ingredients. Temperature, rainfall, soil parameters, pest ranges and cropping patterns are all expected to alter under climate change conditions, and all of these parameters could affect pesticide use and environmental exposure patterns which will alter the risk that these compounds pose to the environment. Here, we report the results of a study to evaluate the impacts of climate change on the exposure of aquatic systems in the UK. Concentrations of a number of case study pollutants, covering a range of physico-chemical properties and uses, were modelled in exposure regimes in the UK using two models recommended by the Forum for the Co-ordination of Pesticide Fate Models and their Use, namely MACRO and PRZM. Model predictions were obtained for current conditions and for expected conditions in the 2080s by parameterising the models for current and future predicted weather conditions, cropping patterns, soil properties and pesticide use patterns. The results show that exposure patterns of the APIs are likely to change in the future. These changes in exposure vary by pesticide type and the region modelled with exposure in some chemical-region combinations increasing and in others decreasing.

WE355
Ranking micropollutants in effluent by exposure indices evaluated via suspect/nontarget screening

P. Naree, Changwon National University / Environmental Engineering; c. younghun, Changwon National University / FEED of Eco-Friendly Offshore Structure; J. Jeon, Changwon National University / Environmental Engineering Information on the occurrence and concentration of micropollutants in effluents from wastewater treatment plants (WWTPs) provides important clues for evaluating the risk and availability of river ecosystems. However, the chemical monitoring work for the numerous trace contaminants is time-consuming, labor-intensive, and cost a lot. To overcome the problems, the efficient monitoring programs have been conducted for limited, but prioritized pollutants. In general, the prioritization has been mainly based on effect/toxicity information rather than exposure and relevant end points. Thus, the low-priority pollutants with high occurrence frequency and concentration have often been underestimated when their effect/toxicity are neither considerable nor well defined. In the present study, a list of prior effluent micropollutants is suggested with a exposure-index based scoring/ranking procedure following qualitative chemical analysis. A scoring table with exposure indices such as occurrence frequency and chronology peak area was applied for the ranking. WWTP effluent samples were taken in september, 2016 and analyzed via suspect/nontarget screening using LC-HRMS (QExactive+ Orbitrap). Within a suspect list, about 60 compounds were tentatively identified and ranked by the score. After purchasing reference standards for high rankers, about 20 micropollutants were orthogonally confirmed and roughly quantified. The quantified micropollutants were mostly pharmaceuticals and personal care products including 9 groups such as analgesics/anti-inflammatoryatories (acetaminophen, mefenamic acid), antibiotics/antifungal (climbazole, flunonazole, sulfamethoxyzole, sulfamethazine), anticonvulsant (carbamazepine, carbamazinepoxide, oxcarbazepine), antithiamises (diphenhydramine, fexofenadine), antihypertensive agent (irbesartan, valsartan), antipsychotic (amitriptyline), and local anesthetics (sulfadiazine, lidocaine). The concentrations for the top ranker, acetaminophen detected in all 7 samples, was ranged up to 1,300 ng /L. The 2nd ranking pollutant was caffeine and followed by cetirizine> mefenamic acid>fexofenadine>carbamazepine>irbesartan> flunonazole>dephethydamine> sulfamethazine. Since some tentatively identified pollutants were left unconfirmed, the prioritized compound list should be updated along with additional confirmations. Nevertheless the ranked list still include highly exposable micropollutants which are worthy for intensive monitoring in effluents.

WE356
Interspecific effects of temperature shifts on life parameters, oxidative stress, and expression of fatty acid synthesis genes and heat shock protein genes in two congeneric copepods Tigriopus sp.

J. Hug, Sungkyunkwan University / Biological Science; J. Lee, Sungkyunkwan University

In this study, we compared the effects of temperature changes on lifecycle parameters, intracellular reactive oxygen species (ROS), heat shock proteins (HSP), S-transferase (GST) enzymatic activity, and gene expression profiles of both the de novo lipogenesis (DNL) pathway and heat shock protein (hsp) genes in the temperate copepod Tigriopus japonicus and the Antarctic copepod Tigriopus kingsejongensis. The median lethal temperature (LT50) and no observed effect level (NOEL) in T. japonicus were determined to be 35.3°C and 32°C, respectively, in 24-hour test to temperature of 2°C per day. In T. kingsejongensis, LT50 and NOEL were determined to be 28.4°C and 12°C, respectively. Levels of ROS and GST activity were slightly elevated (<2×P)

WE357
Effects of water breathing on zooplankton physiology and fitness driven by food characteristics in a long-term enclosure experiment

L. Minguez, LIEC (CNRS UMR 7360, Université de Lorraine) / Laboratoire Interdisciplinaire des Environnements Continentaux, CNRS UMR 7360; E. Sperfeld, University of Oslo / Centre for Ecological and Evolutionary Synthesis (CEES), Department of Biosciences; S.A. Berger, J.C. Nejstgaard, Leibniz Institute of Freshwater Ecology and Inland Fisheries / Dept. Experimental Limnology; M.O. Gessner, Leibniz Institute of Freshwater Ecology and Inland Fisheries IGB Ecotoxicological assays using Daphnia species are generally performed under optimal food and light conditions. However, results of such assays may not adequately reflect stress responses in the wild, since the ability of organisms to cope with adverse conditions critically depends on the amount of available energy. One type of potential stressor that is increasing in importance is terrestrial-derived dissolved organic carbon (tDOC) that causes browning of lakes and streams, but long-term effects of tDOC on freshwater organisms are not sufficiently known. Using a combination of an in situ enclosure experiment and laboratory incubations, we tested whether long-term tDOC exposure affects the physiology and life-history traits of the water flea Daphnia longispina, and whether any observed effects are reversible. Daphnids were collected from a long-term, large-scale enclosure experiment conducted in a clear-water lake in northeastern Germany, where a natural plankton community was exposed to a standard source of tDOC (HuminFeed®). The physiological state of daphnids in the enclosures was followed after addition of the tDOC. In the first week of exposure, daphnids experienced oxidative stress, i.e. an imbalance in favour of oxidative damage, but this response was no longer observed after 36 days. Daphnids and water from the enclosures sampled again after 10 weeks were used to assess survival and reproductive performance under laboratory conditions. Both survival and reproduction were related to sex traits and the elemental and biochemical composition of the daphnids. Surprisingly, daphnids kept in brown water showed higher body and reproductive performance than daphnids kept in clear water (A). This unexpected outcome is explained by higher sex ration and size in enclosures receiving tDOC, related to a higher abundance and biomass of nutritious food algae. Moreover, transplantation of daphnids from A to B enclosure water and vice versa revealed considerable plasticity, as the daphnids were capable of rapidly adjusting their metabolism to a similar level as that observed in the specimens exposed to tDOC. Furthermore, the superior performance under tDOC exposure was maintained independently of the metabolic state of the daphnids. Thus, our study points to the importance of accounting for exposure duration and food quality and quantity when assessing Daphnia responses to environmental stressors such as tDOC.

WE358
Interactive effects of multiple stressors on estuarine processes

A. O’Brien, The University of Melbourne; K. Dafforn, Macquarie University / Evolution and Ecology Research Centre; M. Mayer-Pinto, University of New South Wales / Evolution Ecology Research Centre School of Biological Earth and Environmental Sciences; E.L. Johnston, University of New South Wales / Evolution and Ecology Research Centre; A. Chariton, Macquarie University / Molecular Ecology and Toxicology

Natural systems are threatened by a variety of different anthropogenic stressors. These are often considered in isolation, but in reality most are found in combination and have the potential to interact with different outcomes. Urban systems such as estuaries and harbours are commonly exposed to chemical (e.g. contaminants), physical (e.g. built infrastructural) and biological (e.g. invasive species) stressors. It is important to understand the interactive threats posed by these stressors. Here we use a systematic literature review to explore selected urban stressors and their potential interactions under current environmental conditions. We link the interactive effects to responses in key ecological processes including biogeochemical cycling, primary production and ecological interactions. Using functional endpoints that are context-specific across systems we have the ability to identify important patterns and trends. This allows us to go beyond comparisons that rely on community structural endpoints and are potentially only relevant at local scales.

WE359
Ecology or reproducibility crisis?: - Lessons from a laboratory scale tri-trophic test system

V. Riedl, Environment Department, University of York / Environment Department; A. Agatz, IBACON GmbH / Environment Department; R. Benstead, Fera Science Ltd / Centre for Chemical Safety and Stewardship; R. Ashauer, University of York / Environment

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WE360 Improving tolerance to natural and chemical stressors by inducing early life stages of the rotifer Brachionus sp. C. Hayman, K. Sossey, Université de Liège ULg; P. Baudoin, C. TURIES, INERIS / INERIS

S. JOACHIM, INERIS


Quantitative structure toxicity relationships (QSARs) between chemical hydrophobicity and toxicity have been shown for nearly 100 years in both mammals and fish, typically using the log of the octanol-water partition coefficient (kow). The current study reassessed the influence of mode of action (MOA) on aquatic toxicity-log kow relationships using a comprehensive database of curated and standardized acute toxicity and consensus log Kow values, and weight of evidence (WOE) based MOA classifications. Log kow QSARs were developed as linear regressions of log acute toxicity and log kow for 50 different combinations of taxa (e.g., fish, invertebrates, species-specific) and MOA (6 broad; 3 specific narcosis subtypes). MOA categories included narcosis (non-polar, polar, ester), acetylcholinesterase inhibition, neurotoxicity, electron transport inhibition, ions/osmoregulatory/circulatory impairment, and reactivity. Forty-eight of the 50 MOA-based models were statistically significant (p < 0.05, most p < 0.001), but r² values were generally less than 0.5, particularly for non-narcosis MOAs. The results showed that MOA-based QSR models can improve the accuracy of aquatic toxicity predictions for a range of taxa, and that incorrect classification of a specific acting chemical can result in toxicity prediction errors greater than 1000 fold.

WE364 Data-mining: Making use of aquatic lower-tier data for higher-tier risk evaluation of agrochemicals G. Eck, U. Memmert, E. Eschenbach, Eurofins Regulatory AG

Aptar from delivering relevant toxicity data, standard lower-tier toxicity studies on aquatic organisms also provide valuable additional information for higher-tier testing strategies for risk assessments for plant protection products. While typically only the standard endpoint (e.g. 96-hour LC50) is used, the thorough analysis of existing studies (i.e. individual tests or combined knowledge from different studies) as well as possible adaptations of standard test designs at the organism group of concern may provide valuable facts like time-dependency or reciprocity of effects, magnitude and exposure duration or information about relevant sensitive life stages. This additional information may be relevant in context with higher-tier testing strategies as revised exposure testing or to justify the deployment of time-weighted average surface water concentrations for risk evaluation. Gaining of this additional information should be taken into consideration for planning of lower-tier studies with the most relevant organisms. For example spacing of the test concentrations or additional assessment dates during the test period can maximize the knowledge that may be retrieved from these tests with regard to potential risk refinement. This poster presentation gives examples on how results of standard ecotoxicity studies can more efficiently be used as basis for higher-tier approaches in the environmental risk assessment of agrochemicals.

WE365 Comparison of models and tools for derivation of species sensitivity distributions (SSDs) for use in pesticide risk assessment L. Azevedo, BASF SE, Agrarzentrum Limburgerhof / Global Toxicology; S. Charles, University Lyon 1 / Laboratory of Biometry and Evolutionary Biology; G. Schmidt, BASF SE

EFSA’s guidance document for the risk assessment of edge-of-field aquatic ecosystems (EFSA, 2013;11(7):3290) recommends the use of species sensitivity distributions (SSD) as a second-tier approach for the aquatic risk assessment of plant protection products. For macrophytes, the hazardous concentration to 5% (HC5) of tested species can be attained by deriving a species sensitivity distribution (SSD) composed of effective concentrations to a 50% effect on the growth rate of primary producers (EC50). Various probability distributions are available for the derivation of a SSD (e.g., lognormal, loglogistic) as well as publicly-available tools (RIVM’s ETX, MOSAIC, SSD from the University of Lyon, US EPA’s SSD...
our results, sigmoidal concentration responses (e.g. transcriptomics, metabolomics). Such data often displ
placement for high

effect level accounting for the standard deviation of data (control response + 5D). We will illustrate why this feature makes it more robust and usable whatever the concentration-response model.

WE369 Calculating the true ECx/LCx for non-linear models
Z. Gao, Bayer AG Crop Science Division; A. Solga, Bayer AG; H. Fremdt, Bayer AG Crop Science Division; T. Preuss, Bayer AG / Environmental Safety
ECx and LC50 are most frequently used endpoints for deriving Predicted No-Effect Concentration (PNEC) or Regulatory Accepted Concentration (RAC). ECx is defined as the concentration that shows x% effect compared to the control and LC50 is the concentration at which 50% mortality was observed. These definitions inherently assume the adverse effect at control is 0%. For example, in terms of mortality, the mortality at control should be 0% and when there is background mortality, Abbott's correction has to be applied. In terms of plant growth, percentage of inhibition in growth compared to control is calculated to feed in to the dose-response model. These approaches have bypassed the requirements to use the standardly used probit dose-response model by modifying the data to make the model assumptions valid. However, use of these assumptions can cause serious over- or under-estimation of ECx/LCx due to the ignorance of control variability, the improper use of binomial assumption behind the probit model, etc.

On the other hand, it is nowadays recommended that nonlinear regression models shall be used for dose-response analysis for metric data, which creates another problem in practice because there is inconsistency in the definition of ECx in regulatory context and that in the software implementing these 3 or 4 parameter models procedures. The ECx in programming implementation often assumes the 100% effect is the difference between the baseline response at control and the maximum response at dose level of infinity. EC50 is then defined as the 50% effect between baseline and maximum effect calculated from the model, not with respect to control as how it is defined. This can lead to misinterpretations in the context of regulatory risk assessment. In this study, simulation examples and real data examples will be presented to illustrate the impact of the misuse of the current standard dose-response analysis procedures.

WE370 Review of Dose-Response Analyses in Regulatory Framework
Z. Gao, Bayer AG Crop Science Division; A. Solga, Bayer AG; H. Fremdt, Bayer AG Crop Science Division; T. Preuss, Bayer AG / Environmental Safety
Low effect value ECs (EC10, EC20) derived from dose-response models have been recommended to replace NOECs in the pesticide regulatory context (e.g., new Regulation (EC) No. 1107/2009) The use of NOEC is often criticized because the standard assumption of statistical independence of the responses of null hypothesis testing can be very low due to high variability and small sample size. However, the concept and the limitations behind the various dose-response models have not been systematically addressed. There are ambiguities in the terminologies used such as linear and nonlinear dose-response models. When to use which model is not clear to practitioners. Practical difficulties in the implementation of the methodology lead to questions like what to do when there are no monotonic dose-response relationships, when ECx is superior to NOEC and when NOEC is more appropriate, why the confidence intervals are very broad in the range of low effect dose levels, and so on. In this study, we provide an in-depth review of the various dose-response models and associated assumptions and indications to answer these questions.

Conclusions in which certain dose response model is more appropriate than others were described and illustrated using both real and simulated data examples. We show that the type of data, quantal, count or continuous are important to determine the error structure in the statistical model and the data characteristics provide inherent hints in the choice of dose-response model. The shared parameterizations and curve shapes between the so-called linear and non-linear models are clearer in the model selection process when monotonic dose-response relationships are emphasized. We also identify a few common mistakes in practice due to wrong interpretation of dose-response analysis or wrong understanding of the software implementations. Potential improvements over the decision tree approaches proposed in the EFSA Guidance are discussed. The knowledge gaps related to non-monotonic dose-response relationships are also tackled. The connection between the multiple comparison procedure to derive NOEC and the model-based dose-response analysis are presented and hybrid approaches are discussed.
Deriving no effect levels using probabilistic approaches: Application to trichloroethylene (TCE) and potential impacts to risk-based exposure concentrations

N.D. Forsberg, Arcadis U.S., Inc. / Environmental and Molecular Toxicology; B. Magee, S. Sager, ARCADIS US Inc

八卦 that hazard quotient (PEC/PNEC ratio) really represents and whether it is a realistic therefore ex...

Aquatic risk assessments for plant protection products (PPPs) can often be...Assessment; A. Abu, J. Carnall, M. Franey Environmental Science; A. Lawrence, Cambridge Environmental Assessments / Department of Biological Sciences; A. Gardiner, F. Pickering, SETAC Europe 28th Annual Meeting Abstract Book

Keeping it real: multidisciplinary approaches to aquatic risk assessment

D. Warnecke, B. Weber, D. Warnecke, RIFCON

The use of PRA approaches to calculate DNELs using trichloroethylene (TCE) as an example. This will focus specifically on TCE’s non-carcinogenic effects and incorporate the variability and uncertainties associated with dose-response modeling, physiologically-based pharmacokinetic modeling, assignment of AFs, and the choice of allowable risk level. The potential impacts of using PRA approaches to calculate DNELs will be discussed in relation to resulting risk-based exposure concentrations.

WE372 Aquatic higher-tier exposure testing of pesticides - from complexity to simplicity

G. Eck, E. Eschenbach, Eurofins Regulatory AG

Field exposure of pesticides is usually characterized by time-variable substance entries into water bodies resulting in complex exposure patterns which often significantly deviate from the constant exposure in standard ecotoxicity tests with aquatic organisms. As an appropriate risk refinement option higher-tier exposure testing is proposed in the current EFSA guidance document for aquatic risk assessments providing the possibility to define ecotoxicologically relevant test concentrations and meaningful link to FOCUS exposure modelling outputs. Studies designed to reflect realistic exposure often result in lower effects. However, FOCUS exposure patterns are frequently challenged in regard to their representativeness for the variety of possible field scenarios and hence are generally not accepted as valid refinement option by several EU Member States. Besides, it is often difficult to generalize various critical patterns of different FOCUS scenarios for an efficient and to align these generic patterns with sensitive life stages of the organisms of concern. Practical aspects, types of effects and life traits of test organisms add to the complexity of designing reasonable higher-tier exposure studies. The challenge is to balance representativeness and practicability of test designs. Representativeness can for example be enhanced by multi-year modelling simulations where the variability of treatment and climate conditions are taken into account. Detailed analysis of the multi-variable predicted exposure scenarios as well as a detailed analysis of available standard toxicity data is required to develop meaningful test designs and strategies. Generating simplicity from complexity rather than matching exactly the FOCUS modelling exposure pattern is proposed as potential solution to concerns on representativeness as well as practicability for ecotoxicology testing and finally acceptability in a regulatory context. The poster will present examples for the generation of realistic test designs and strategies that are considered to meet objections towards higher-tier exposure testing as adequate means for refinement of aquatic risk.

WE373 Keeping it real: multidisciplinary approaches to aquatic risk assessment


Aquatic risk assessments for plant protection products (PPPs) can often be complex, comprising multiple crops, application rates, Member States (MSs) and therefore exposure scenarios. A critical task of these scenarios is that the hazard quotient (PEC/PNEC ratio) really represents and whether it is a realistic representation of the true risk. A number of assumptions and worst-case parameters are used within the Tier I risk assessment, both on the exposure (predicted exposure concentration; PEC) and the effect (predicted no effect concentration; PNEC) side of the equation. To maximise the realism within the risk assessment, it is therefore advantageous to take a multidisciplinary approach, involving specialists in environmental fate, exposure modelling, aquatic ecotoxicology testing and regulatory ecotoxicology when developing refinements for the risk assessment. By developing integrated solutions, it is possible to progress from theoretical to more pragmatic approaches to assessment. For example, the use of probabilistic approaches is proposed to develop alternative models, and designing modified exposure studies to more accurately mimic these exposure profiles; etc. The aim of this poster will be to illustrate how different disciplines can work together to challenge the default assumptions of standard aquatic risk assessment, thus enabling appropriate refinement options to be derived and together design optimal solutions that are closer to addressing the real risks, rather than the theoretical ones.

WE374 Critical aspects of higher-tier laboratory exposure testing with different aquatic organisms

G. Gansior, Eurosins AgroScience Ectox GmbH; U. Memmert, G. Eck, E. Eschenbach, Eurofins Regulatory AG; C. Hafner, Eurosins AgroScience Ectox GmbH / Aquatic Ecotoxicology

Aquatic exposure testing. The aim is to achieve a more realistic perspective under consideration of the intended (worst-case) application pattern of a specific plant protection product. This option of risk refinement is also reflected in the recent Aquatic Guidance Document (EFSA, 2013). Here we present a partial life cycle test with zebrafish (Danio rerio) performed in a static water sediment system under poultry sophisticated exposure conditions with regard to real-life scenarios in aquatic ecotoxicology studies and their sensitive life stages are to be considered. Finally, test designs are presented as practical considerations regarding the handling of test species, the test item dosing methods in order to realise desired exposure patterns and active substance characteristics. A systematic overview on critical aspects with regard to the conduct of studies will be presented to assist in designing higher-tier laboratory exposure tests with aquatic test organisms.

WE375 Repeated pulsed exposure in a partial life cycle test with zebrafish: Keep it realistic!

M. Teigel, Fraunhofer IME / Ecotoxicology; B. Weber, D. Warnecke, RIFCON GmbH Goldbergstr Hirschberg Germany

Refined exposure tests can be used to transfer more realistic exposure conditions into standardised aquatic exposure testing. The aim is to achieve a more realistic perspective under consideration of the intended (worst-case) application pattern of a specific plant protection product. This option of risk refinement is also reflected in the recent Aquatic Guidance Document (EFSA, 2013). Here we present a partial life cycle test with zebrafish (Danio rerio) performed in a static water sediment system under pulsed exposure conditions. The test design allows addressing effects on different sensitive life stages of fish, subsequently and multiply exposed to the test item within the same environment. In the first part, adult spawning fish (i.e. the parental generation, P0) were exposed to 4 pulsed applications at weekly intervals. The performance of the reproduction in terms of egg numbers and fertilisation rate was assessed. The second part was initiated by placing fertilized eggs from the parental groups into the same water sediment systems. This F1 generation was also exposed to 4 pulses of the test item at weekly intervals. Survival and growth of the early life stages were assessed. Other endpoints like endocrine-disruptor effects can be covered by measurement of vitellogenin and histopathological analysis of fish gonads. Glass aquaria of a total volume of 30 L were used and filled with a layer of artificial sediment to ensure stability of the test system throughout the 9-weeks test period. After post-application, survival and growth of the individual fish was typically monitored. The evaluation of biological effects was based on mean measured as well as on area under the curve concentrations (AUC) of the test substance in order to be able to compare it to predicted environmental concentrations (PEC\textsubscript{\textit{env}} calculated with the FOCUS tools). The analysis of the AUC as well as of the DT\textsubscript{50} values showed that the diffusion profile in the test systems were in line with the predicted exposure profiles in the field. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible distortion of the static system. However, it was demonstrated that the performance of the parental as well as the filial fish was fine and in line with the quality criteria set by the official test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address both complex exposure regimes and specific endpoint issues.

WE376 Pulsed exposure of fish at sensitive life stages: The 'worst case' challenge.
Eggs and larval fish test, an alternative method to marine fish exposure: Sensitivity and interest of early life stage.

TIER2+: Developing the Tools for Future Risk Assessment - New Chronic Invertebrate Test Systems and the Application of Realistic Exposure Scenarios

Optimisation of a chronic toxicity flow-through system to investigate the adverse effects of chemicals to Daphnia magna

Lack of Relevance of Normalized Hindlimb Length Measurement in Assessment of Thyroid Disruption in the Amphibian Metamorphosis Assay

Acute toxicity test using Mediterranean fish species (Dicentrarchus labrax L., 1758): Intercalibration exercises towards standardized procedure
Diatoms are not only part of the risk assessment (RA) for plant protection products, but also standard test organisms for the RA for pharmaceuticals and chemicals (REACH). Especially chemicals as basic element for the synthesis of more complex products show a broad variety of characteristics from well water soluble, stable and non-toxic to hardly water soluble, unstable, volatile and toxic for water organisms. The group of chemicals with one or more of the latter characteristics is a challenge for the toxicity test with aquatic organisms. The OECD guidance document on aquatic toxicity testing of difficult substances and mixtures (23) provides some information for the “standard test items” with difficult test items. The test was conducted, but due to the number of uncontrollable characteristics of these different substances, some innovation is required to find the best test design for the individual chemicals. We show examples for the toxicity testing of difficult test items starting with the investigation of the characteristics of the test item in the respective test water (water solubility, stability in water, photolysis effect, adsorption, storage conditions) and the European sea bass (Dicentrarchus labrax L., 1758) larvae (species widespread in Mediterranean sea), two intercalibration exercises were conducted by 7 Italian laboratories, according to ISO/IEC 43-2:1997 and ILAC-G13:2000. To this end, for every exercise, the laboratories tested two reproductively isolated (24h-48h) sea bass larvae (50-70 days old) to the toxicant reference (Sodium Dodecyl Sulfate) concentrations: 6.31-3.98-2.51-1.58-1.00 mg/L and control. The LC50 (Trimmed Spearman-Karber method: TSK) mean valueranged from 2.93±0.52 mg/L to 3.98±0.99 mg/L to 24h; and from 2.90±0.50 mg/L to 3.87±1.03 mg/L to 48h, respectively. The intra and inter laboratory variability of the tests were verified and Z-values (2) were computed. Statistical analyses showed no significant differences in the data produced by most of the laboratories. The results indicate the standardization procedure is in advanced stage.

**WE384 Activity based Collombola sampling may improve the data of field studies for regulatory purposes**

M. Mack, A. Appeltauer, J. Ilić, Eurofins Agroscience Services Ectosum GmbH; S. Knaube, EAS Ectosum GmbH / Ectox Field

Soil micro-arthropod field studies are carried out as part of the risk assessment of plant protection products. Those studies followed the proposed study design for soil organisms by Römkel et al. (2009). Soil cores are taken in the field and afterwards soil organisms are extracted from the soil using high gradient extraction. Until now little is known about vertical movements of collombolans. Especially in long periods with high temperatures and low precipitation, a high number of collombolans might mitigate in deeper soil layers as included in the standard sampling scenario of 5 - 10 cm soil cores. Therefore it might be useful to cover also deeper soil layers, which contain potentially more specimens at the sampling time. One activity based trapping method for soil microarthropods would be the slide traps which were presented at SETAC 2016 by Dehelean et al. Our poster will discuss possible advantages for the combination of soil core and slide trap sampling and will present first results from the comparison of soil core and slide trap catches. Römkel, J., Schmelz, R., Knaube, S., 2009: Field studies for the assessment of pesticides with soil mesofauna, in particular enchytraeids, mites and nematodes: Design and first results. Soil Organisms, 81: 237-264. Stefan-Bogdan Dehelean et al., 2016 Stratification of soil arthropods in topsoil layers, SETAC Europe 26th Annual Meeting, Nantes, France.
The biogeochemical cycles of several lanthanides (LNs) are being progressively disrupted by their increasing use in industrial sectors such as high-tech applications and clean energy generation. Except for a few hotspots located close to industrial plants or other discharge points, LN concentrations remain essentially low (i.e., in the µg/L range or lower), but the paucity of available data has fostered research on their possible effects on biological organisms. Getting reliable information on the ecotoxicological potential of LNs is also important in view of the possible (re)opening of mining activities in response to the current monopoly of LN production by the People’s Republic of China. In this context, testing LNs for ecotoxicity following established standard protocols must consider the peculiar chemistry of these elements if meaningful results are to be obtained and used to establish regulatory limits. After addition to ecotoxicological media, typically in the form of soluble chloride salts, LNs can rapidly form complexes with phosphates or carbonates or undergo hydrolysis. Due to the low solubility of LN-phosphates and LN-carbonates, precipitates may form. When the formation of LNs in solution aged for 4h and 72 h which, based on previous research, would be long enough to observe sufficient changes in the ecotoxicity of solutions aged for different periods. Chromium(III) was chosen as a model contaminant, but the general approach is applicable to all elements forming poorly soluble species and potential colloidal precipitates in ecotoxicological test media. In medium aliquots amended with Cr(III) (range 0.005 to 1,25 mg/L), renewal every 24 h was not sufficient to obtain stable exposure concentrations (i.e. ±20% of the initial value) throughout the duration of the test. The actual exposure range (estimated as time-weighted mean concentrations) was between 5 and 275 µg/L and was used to estimate the Cr(III) EC50. On the other hand, concentrations remained stable over time and agreed with expected values in comparative experiments performed with Cr(III) (emergent, colonisers and sweep nets) support or contradict a test result. At CEA we use a range of sampling methods to collect data on aquatic macroinvertebrates within our mesocosm studies, including emergence traps, colonisers and sweep nets. Each sampling method captures a particular species; sweep nets are used to capture fast-moving pelagic organisms whereas colonisers are left in-situ to allow benthic organisms to enter the trap. In some cases, the same species can be caught using different sampling methods, such as mayflies, damselflies and caddisflies, and this can be from various stages in their life cycle. Comparing the data for the same taxa from different sampling methods can be helpful in creating and overall picture of how that taxa is responding within the mesocosm system. This can be helpful in deciding whether statistically significant differences are biologically relevant; for example, if a statistically significant difference to the control is only observed in one out of three sampling methods used for a particular taxa, this may indicate this is due to natural variation rather than the influence of the test item. Here, we will review Latin daisy, damselfly and mayfly data from past CEA studies where statistically significant differences have been observed and highlight cases where different sampling methods (emergent, colonisers and sweep nets) support or contradict a test-item effect. The ecological risk assessment procedure according to Directive 2000/18/EC for Gene Modified Organisms used as medicinal products H. Weigt, Fraunhofer Institute for Toxicology and Experimental Medicine ITEM / Chemical Risk Assessment; E. Weber, Fraunhofer Institute for Toxicology and Experimental Medicine ITEM; M. Butke, Hochschule Emden-Leer; S. Schwanbeck, Fraunhofer Institute Toxicology and Experimental Medicine / Chemical Risk Assessment; A. Bittner, Fraunhofer ITEM / Chemical Risk Assessment The deliberate release of genetically modified organisms (GMOs) including GMOs of...
used as medicinal products, e.g. gene therapies, into the environment is regulated by directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001. An integral part of the directive regulates the provision of information on the GMO and, based on this, the risk management with regard to the environmental effects of such releases. As regulated by this directive, a publicly accessible database (the “GMO Register” of the JOINT RESEARCH CENTER of the EU) contains information about all GMOs under EU authorization. As of 07.11.2016, there were 238 entries of medicinal GMOs in the “Summary Notification Information Format (SNIF).” SNIFs are prepared as a summary document of the confidential environmental risk assessments (ERA) by the respective Sponsors of clinical trials in the EU and evaluated during the clinical trial application by the national competent authorities. This enterprise, inter alia, information regarding the GMOs and the parental organism’s nature, release, environmental interactions, monitoring, waste treatment and emergency response plans. We strive to assess information concerning the environmental risk, derived measures and the overall standard of SNIFs concerning compliance with the regulatory requirements. To do so, we picked a homogeneous group of GMOs, namely gene modified Adenovirus, the most frequently used vector in gene therapy trials worldwide. Relevant information were entered into a database and categorized, applying unified vocabulary. Different challenges regarding the information available within the SNIFs were identified by analyzing the database: in several cases mandatory information was not available, e.g., monitoring plans, and in other cases the SNIF documents were misinterpreted, e.g., the connection between replication, dissemination and survivability was interpreted here by the OSHA. Although the primary basis has been the environment in which the data, information gaps and inconsistencies are transferable to other species as well. Consequently, it is proposed to specify some parts of the SNIFs in order to make more reliable information transparently available.

**WE391**

**PBT evaluation 20 years on: is it time to reconsider the technical progress made in risk assessment methodology?**

P. Thomas, C. Durou, CEHTRA SAS /

In the EU, the ecotoxicological dataset for a chemical is used for the purposes of prospective risk assessment (PRA) and of PBT assessment. While the PRA aims at determining the use conditions and risk management for which the environment is safe, the PBT assessment aims at identifying chemical for which effects on the long-term are considered unpredictable and that environmental exposure is difficult to reverse. The scope of this poster is to discuss, in the light of technical and scientific progress: For which PBT-Like and certain PBT chemical, PRA can now be carried out The justification of the numerical criteria behind the identification of PBT chemicals is PBT of the situation. The aim of this work was to compare the approaches of the EU and of other countries. The numerical criteria were established in the late 1990's by OSPAR. This primary basis has been the environment in which the data, information gaps and inconsistencies are transferable to other species as well. Consequently, it is proposed to specify some parts of the SNIFs in order to make more reliable information transparently available.

**WE392**

**UVB block method for estimating expected mixture toxic pressure of substances of Unknown or Variable composition, Complex reaction products or Biological materials**

D. van de Meent, Association of Retired Environmental Scientists AREs / Environmental scientists, Association of Retired Environmental Scientists AREs; D. De Zwart, DiZ Ecotoc / Centre for Sustainability Environment and Health; J. Hermens, Utrecht University / Institute for Risk Assessment Sciences; N. van Straalen, Association of Retired Environmental Scientists AREs / Department of Ecological Sciences

We have developed a spreadsheet calculation tool for chemical safety assessment of UVB substances. The tools adopts the approach of Concave’s Hydrocarbon Block Method for chemical safety assessment of complex petroleum substances. The tool is meant to be used for demonstrating ‘safe use’ of chemicals, as required for registration of substances under REACH. The tool makes use of scientifically up to date versions of the exposure models SimpleTreat and SimpleBox, combined with state-of-art expected mixture pressure calculation using the Van Straalen-Aldenberg convolution integral. The tool estimates the addition of toxic pressure to the ambient toxic pressures in local, regional and continental EU environments, expected from the UVCB mixture. It is proposed that ‘safe use’ is demonstrated sufficiently well by showing that the UVCB under study is expected to contribute negligibly to ambient toxic pressure in the environment. The proposed ‘safe use’ calculation method has been tested in isolation relatively well studied UVCBs. In the poster briefly explains the new UVCB block method and illustrates its potential with the outcomes of test calculations.

**WE393**

**Evaluation of hypohygyngeal glands development in Honeybees (Apis mellifera L.) from toxicity studies in the light of current guidelines (EFSA and OECD)**


Honey Bee (Apis mellifera L.) is a species that belongs to a group called ‘beneficial insects’. All arthropods from this group play the important roles in nature, albeit bees go a few steps forward and they also find application in the food, pharmaceutical and others industries. With the current decline in bee’s colony numbers, these arthropods should be handled with extreme caution. Therefore, it is extremely important to assess the risk for non-target organisms for which plant protection products are often more toxic than pests of agricultural crops. This assessment is related not only to the direct influence of chemicals on the number of bee populations, but also indirectly - through the impairment of the ability to raise the larvae, for example by disturbing the development of hypohygyngeal glands (HPG) responsible for the production of ‘milk’ containing proteinous substances to feed larvae and queen. By 2017, the only document regulating the toxicity study of chemicals on bees was the EFSA document (EFSA Journal 2013;11(7):3295), which included continuous access to distilled water and pollen evaluation of HPG. However, in 2017, the new OECD guideline (no. 245) was introduced, in which the methodology of chronic toxicity testing was changed compared to the EFSA document. Changes occurred in the way of dealing with bees – there is no access to distilled water and pollen, and no evaluation of HPG. It is a significant change, because according to the literature the hypohygyngeal glands do not develop correctly in these conditions, which exclude the assessment of HPG. Hence OECD guideline probably does not consider it as endpoint in the study. As previous study has shown, chemicals can have influence on development of hypohygyngeal glands, without causing mortality and morbidity. This matter is worthy considering and should be investigated further, in order to introduce the evaluation of hypohygyngeal glands as an endpoint in toxicity testing of chemicals on bees.

**WE394**

**Assessing toxicity to Daphnia magna using movement parameters**

T. Dedol, Department of Biology, University of Osijek / Department of Biology; D. Hackenberger, GeoNatura; B. Hackenberger, Department f Biology, University of Osijek

The OECD guideline for testing the toxicity of chemicals to aquatic organisms (OECD) provides a standardized approach to evaluate the toxicity to aquatic organisms. In the last years, some movement parameters (e.g. swimming speed) have been included in the toxicity testing of aquatic organisms. The aim of this work was to compare and examine the changes of swimming behaviour of Daphnia over time and under the influence of sub-lethal concentrations of ZnCl2, based on 12 chosen movement parameters. Organisms obtained from a natural habitat acclimatized to laboratory conditions were exposed to different sub-lethal concentrations of ZnCl2. Daphnia were placed in each transparent plastic Petri dish in prepared solutions of the test concentration. The recording started instantly upon exposure of the organisms to the toxicant (t0), as well as 1 h, 24 h and 48 h of exposure (dt=1 h, dt=24 h, dt=48 h). The recording and analysis of motion were carried out in Python, implementing OpenCV, TrackPy and NumPy packages. Analysis of the obtained data showed that the introduction of exposure affects the movement parameters, regardless of the concentration of the toxicant. Although, some movement parameters showed significant correlation with concentrations of toxicants and hence can be used as an early biomarker of exposure.

**WE395**

**The validation of analytical methods in ecotoxicology**

I. Pedall, A. Rastall, A. Sagner, M. Faupel, Rifcon GmbH

The validation of analytical methods (regulated by SANCO/30299/rev 4.) used in support of ecotoxicological studies has become an important aspect of the
registration process for plant protection products. When Regulation (EC) No. 1107/2009 came into force, adherence to the SANCO/3029/99 rev 4. Guidelines became obligatory. This has resulted in serious implications for the registration process because ecotoxicological studies may well now be rejected on the basis of inadequate analytical methodology or incomplete analytical data although the studies have previously been accepted. Here we give an overview of current requirements and provide a checklist that can be used to evaluate analytical methods in ecotoxicological studies.

WE396 A new pulsed-exposure early life stage test design for rainbow trout on an insecticide. Refining OECD Guideline 210 to meet the needs of EFSA Aquatic Guidance 2013

C.S. Ramsden, AgroChemex Environmental Ltd / School of Biomedical and Biological Sciences; C. Gamblin, AgroChemex Environmental Ltd; W.R. Jenkins, W R Jenkins / Regulatory Affairs Ecotoxicology; S. Norman, RidgewayEco

Constant-exposure in OECD TG 210 Fish Early Life Stage studies is unrealistic for fast-dissipating pesticides compared to edge-of-field water-bodies. EFSA Aquatic Guidance (2013) allows aquatic toxicity studies to be modified so the exposure-profile (peak-height, pulse-duration, number of pulses) is comparable to the worst-case predicted field-exposure. In the present study on a synthetic pyrethroid (SP) insecticide, a novel method was developed to simultaneously assess effects on 3 early-life stages of rainbow trout. The TG 210 design was modified to incorporate a worst-case time-variable exposure profile in tanks containing a 10 mm sediment layer and stainless steel mesh barrier to allow water movement but prevent fish disturbing the sediment. Life stages used were firstly fertilised eggs’, ‘alevins’ (non-feeding larvae) and free-feeding ‘swim-up’ fry. To ensure physical separation of the 3 life stages within the tank, eggs and alevins were each held in a glass incubation tube with a mesh base. A control group plus 5 concentrations were used. To start, each group had 4 replicate tanks each with 50 eggs, 20 alevins and 20 swim-up fry. The swim-up fry were exposed to 20 hour static exposure phases on Days 0 and 14. The study duration for organisms starting as ‘eggs’, ‘alevins’ and ‘swim-up’ fry was 72, 45 and 31 days respectively. This allowed for the assessment of effects over a period including at least 2 weeks of growth after initiation of free-feeding for each of the 3 life stages. Standard end points were assessed including hatch success, survival, growth and clinical signs (e.g. loss of equilibrium and coagulation). To assess the potential neurotoxic action feeding behaviour was categorised as active, passive and not feeding. This refined-exposure study showed that 3 critical life stages of fish can be tested simultaneously, whilst complying with the fundamental elements of TG 210. Control hatch and survival rates were both > 95%. The design allowed the direct comparison of the sensitivity of each life stage to the aquatic pulse profiles. Swiss roll and swim-up fry was the most sensitive exposed life stage, based on clinical signs, feeding and slightly reduced growth. Swim-up of exposed alevins was delayed at high treatment levels. Exposed eggs were unaffected.

Distribution, transformations and biological effects of incidental nanoparticles and nanoplastics in the environment from a novel point of view (P)

WE397 Dissolution of Different Silica Nanoparticles in Aqueous Matrices


Since centuries, silica (SiO₂) is used in large scale industrial applications, such as cement manufacture or glass production. In these applications, SiO₂ is used in its bulk form. Recently, SiO₂ in nanoparticulate form has broadened the range of applications, both in large scale, e.g. as anti-cake agent in food industry, or owing to its abrasive effect in cosmetics; and in small scale, for the production of biosensors, swim-up fry. There were 22 hour static times [1]. The use of silica nanoparticles (SiO₂-NPs) as a delivery vehicle for molecules in plants is being investigated [2], demonstrating their potential in environmental applications. Many of the current uses increase the likelihood that SiO₂-NPs could accumulate in the environment and in food webs. Therefore, it is crucial to investigate the dissolution of SiO₂-NPs in different environments. Besides information about the degradability of the nanomaterials, this knowledge will also allow to produce more environmentally friendly products. Here, we present the results of a method development to quantify the dissolution of different SiO₂-NPs in aqueous media in order to determine the dissolution kinetics. This method relies on the use of inductively coupled plasma optical emission spectroscopy (ICP-OES) for the quantification and the parallel characterisation of the particles by transmission electron microscopy (TEM) and dynamic light scattering (DLS). A simple setup based on dialysis membranes, and a sampling protocol are in the process of being established. The first results indicate that is possible to detect the dissolved fraction of SiO₂-NPs roughly 60 nm in diameter within about one day. Long-term dissolution experiments will be performed in the coming months to determine the dissolution kinetics more precisely. This setup will serve as a tool to assess the behavior of SiO₂-NPs in environmental media. [1] Bark TK, Sahu B, Swain V. 2008. Nanosilica— from medicine to pest control. Parasitology Research. 103:253, [2] Torny E, Trewyn BG, Lin VSY, Wang K. 2007. Mesoporous silica nanoparticles deliver DNA and chemicals into plants. Nature Nanotechnology. 2:295. Acknowledgement - The authors thank the Swiss National Science Foundation (project 168187) and the Adolphe Merk Foundation for the support and funding of the study, and Laura Rodriguez-Lorenzo for her precious advice and suggestions.

WE398 Occurrence of fullerene aggregates in Mediterranean rivers: Two cases of study

J. Sanchís, IDAEA-CSIC / Water and Soil Quality Research Group; R. Milacic, Jozef Stefan Institute (JSI) / Department of Environmental Sciences; M. Farre, IDAEA-CSIC / Environmental Chemistry; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry

Fullerenes are carbon nanomaterials that have many potential applications in nanotechnology and that can be generated in some combustion processes. Since their environmental effects and behaviour are uncertain, fullerenes are considered emerging contaminants and during the last years they have been included in some analyses as emerging pollutants. Several researchers have reported the presence of fullerenes in water systems. In order to assess the environmental risk of fullerenes it is important to enlarge the dataset and to characterize the concentrations of these nanomaterials in different rivers. In the present work, C₆₀ fullerenes, C₇₀ fullerenes and five functionalized derivatives were determined in water and sediment samples from two Mediterranean rivers. The first case of study was located in the Sava River (Southeastern Europe), where more than 30 samples were studied in two sampling campaigns. In the second case of study, samples of estuary water, wastewater, river water and coastal water from the Ebro River delta were analysed. In both studies, C₆₀ was the most ubiquitous compound and it was detected for the first time in the marine environment, although its concentrations were below the ng/l order in all the cases. The exotic fullerene TFB-C₇₀ was also detected from environmental sample from the Sava River. The results show that fullerenes are present in the aquatic environment although at concentrations far below than those levels that are expected to cause any toxic effect to aquatic organisms [4]. However, the presence of C₆₀ may modulate the toxicity of some co-contaminants, as described elsewhere [5] Acknowledgement: This work has been supported by the European Communities 7th Framework Programme under Grant Agreement No. 603629-ENV-2013-6.2.1-Globaqua and by the Spanish Ministry of Economy and Competitiveness through the project Integra-Coast (CGL-2014-56530-C4-1-R). It has also received funding from the Generalitat de Catalunya (Consolidated Research Groups “2014 SGR 418” Water and Soil Quality Unit). References [1] Astefanee, Alina, et al. Analytica chimica acta 682 (2015): 1-2 [2] Torney F, Trewyn BG, Lin VSY, Wang K. 2007. Mesoporous silica nanoparticles deliver DNA and chemicals into plants. Nature Nanotechnology. 2:295. [3] Zakaria, Susanna, et al. Environmental Science and Pollution Research (2017): 1-10. [4] Freixa, Anna, et al. The Science of the total environment 619 (2017): 328. [5] Sanchís, Josep, et al. Environmental science & technology 50.2 (2015): 961-969.

WE399 Occurrence, fate and behaviour of fullerenes in the environment

M. Farre, IDAEA-CSIC / Environmental Chemistry; J. Sanchís, IDAEA-CSIC / Water and Soil Quality Research Group; Y. Aminot, University of Plymouth; E. Abad, IDAEA-CSIC; A.N. Jha, Plymouth University / Biological Sciences; J.W. Readman, University of Plymouth / Biogeochemistry Research Centre; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry

The occurrence, fate and behaviour of carbon nanomaterials in the aquatic environment are dominated by their functionalization, association with organic material and aggregation behaviour. In particular, the degradation of fullerene aggregates in the aquatic environment is a primary influence on their mobility, sorption potential and toxicity. In this presentation, a summary of the occurrence of fullerenes in environmental matrices performed in different studies of our group will be presented. The analytical approach to investigate seven fullerenes (C₆₀, C₇₀, C₆₀-N-methylfulleropyrrolidone, [6,6]-phenyl C₆₀ butyric acid methyl ester, [6,6]-thiényl C₆₀ butyric acid methyl ester, C₆₀ pyrrolidine-tris-acid ethyl ester and [6,6]-phenyl C₆₀ butyric acid methyl ester) in waters, soils and sediments combines an on-line solid-phase-assisted solid-phase microextraction (SPME-SPSME) followed by liquid chromatography (LC), using a pyrenyl(propyl) group bonded silica based column, coupled to a high-resolution mass spectrometer (HRMS) using atmospheric pressure photo ionisation (APPI) in negative ion mode. Main results of these studies showed levels of pg/m³-lg/m³ in atmospheric aerosols, pg/g-ng/g in soils and pg/l-ng/l in river waters. The composition of different fullerenes including pristine fullerenes (C₆₀ and C₇₀) and functionalized ones from the engineered origin will be discussed. In addition, different degradation studies of fullerenes in water suspensions emulating different environmental conditions and during a wastewater treatment will be presented. Degradation studies have been carried out under controlled conditions of salinity, the humic substances content, the pH and the sunlight irradiation. The results of degradation studies will show that to up to ten transformation products are produced, including epoxides and dimers. Finally, the kinetics of generation of each transformation product will be well presented.

WE400
The influence of engineered surface coatings on nanomaterial stability in a complex, natural medium

M. Surette, Oregon State University / School of Chemical, Biological, and Environmental Engineering; J.A. Nason, Oregon State University / Chemical Biological and Environmental Engineering

The colloidal stability of engineered nanomaterials (ENMs) within aquatic environments is a major concern. The fate of ENMs was investigated using simplified, synthetic mediums that demonstrated that ENM stability is strongly influenced by the engineered surface coating enveloping the ENM. However, it is uncertain whether this coating will continue to dictate particle stability when the ENM is dispersed within a complex, natural medium. Instead, it has been suggested that the “eco-corona” acquired by the ENM via interactions with the surrounding environment will govern ENM stability. This implies that within these mediums, engineered surface coatings will have a negligible impact upon ENM stability. The aim of this research was to investigate this subject further and determine whether ENMs’ engineered surface coating remains a relevant factor effecting ENM stability in a complex, natural medium. In Samples of a local freshwater river to represent a complex, natural medium, a suite of batch experiments were conducted. Each batch was dosed with a single model ENM, which included 12-15 nm gold-core nanoparticles (AuNPs) with different surface coatings (e.g., diverse surface charges, stabilization mechanisms). Aliquots were collected from each batch over time, immediately centrifuged to remove large particles/aggregates, and the supernatant collected for analysis via ICP-OES. From this, the concentration of unaggregated AuNPs remaining in the supernatant over time was tracked. As a result, we found that neutral ENMs were destabilized. More importantly, however, was that both the neutral and negatively-charged ENMs remained stable throughout the duration of the experiment (8 hrs.). This suggests that the surrounding environment did not affect the stability of these ENMs and demonstrates that ENM stability is influenced by the engineered surface coating, even after interacting with a complex, natural medium.

WE401 Engineered Nanoparticles interactions in secondary wastewater treatment: removal kinetic and efficiency during activated sludge stage.

V. Cappadona, University of Strathclyde / Civil and Environmental Engineering; R. Skuce, Scottish Water Horizons Ltd; C. Knapp, V. Phoenix, University of Strathclyde / Civil and Environmental Engineering

The rapid evolution of nanotechnology poses a unique and significant challenge for wastewater treatment plants (WWTPs). Engineered Nanoparticles (ENPs) are already utilized in a diverse array of applications, including cosmetics, optics, medical, and batteries. As the environmental changes in the surrounding environment did not affect the stability of these ENMs and demonstrates that ENM stability is influenced by the engineered surface coating, even after interacting with a complex, natural medium.

WE402 Fate factor of engineered TiO\textsubscript{2} nanoparticles in aquatic and terrestrial natural environments

A. Schulz, University of Strasbourg (UdS); G. Quaranta, Université de Strasbourg / CNRS / EOST/TLHYGES; S. Lawnickz, University of Strasbourg / LHYGES Nanoparticles are defined as nano-objects between 1 and 100 nanometers in size. Engineered TiO\textsubscript{2} nanoparticles are used in several fields such as construction, cosmetic and food which leads to an important production and inevitably to emissions generating environmental impacts. To quantify them, the Life Cycle Assessment (LCA) is a powerful method that is able to characterize TiO\textsubscript{2} ENPs according to their fate in environmental media and their effects on ecosystems and human health. The main objective of this study is to determine the engineered TiO\textsubscript{2} nanoparticles (TiO\textsubscript{2} ENPs) fate according to two approaches: experimental and by calculation. For this purpose, it requires firstly to detect and quantify TiO\textsubscript{2} ENPs in a natural environment according to the life cycle impact assessment method calculation. During the study, we found that ionic strength, pH, percentage of organic matter, soil composition (percentage of clay, silt and sand) or size and concentration of TiO\textsubscript{2} ENPs are parameters which matter in TiO\textsubscript{2} ENPs fate in soils, water and sediments. Furthermore, the first results obtained showed that the sampling point located upstream of the production site has the lowest concentrations of titanium dioxide in soil and sediments. This point is used as a reference and allows the study of the fate of TiO\textsubscript{2} ENPs in a natural environment according to the life cycle impact assessment method calculation. In this study, we have investigated the impact of TiO\textsubscript{2} ENPs in aquatic and terrestrial environments has been shown to control ENM environmental fate. Prior research using simplified, synthetic mediums has demonstrated that ENM stability is strongly influenced by the engineered surface coating enveloping the ENM. However, it is uncertain whether this coating will continue to dictate particle stability when the ENM is dispersed within a complex, natural medium. Instead, it has been suggested that the “eco-corona” acquired by the ENM via interactions with the surrounding environment will govern ENM stability. This implies that within these mediums, engineered surface coatings will have a negligible impact upon ENM stability. The aim of this research was to investigate this subject further and determine whether ENMs’ engineered surface coating remains a relevant factor effecting ENM stability in a complex, natural medium. In Samples of a local freshwater river to represent a complex, natural medium, a suite of batch experiments were conducted. Each batch was dosed with a single model ENM, which included 12-15 nm gold-core nanoparticles (AuNPs) with different surface coatings (e.g., diverse surface charges, stabilization mechanisms). Aliquots were collected from each batch over time, immediately centrifuged to remove large particles/aggregates, and the supernatant collected for analysis via ICP-OES. From this, the concentration of unaggregated AuNPs remaining in the supernatant over time was tracked. As a result, we found that neutral ENMs were destabilized. More importantly, however, was that both the neutral and negatively-charged ENMs remained stable throughout the duration of the experiment (8 hrs.). This suggests that the surrounding environment did not affect the stability of these ENMs and demonstrates that ENM stability is influenced by the engineered surface coating, even after interacting with a complex, natural medium.
have produced undesirable effects in many marine organisms. Marine phytoplankton is vital in marine ecosystems, as microalgae are at the bottom of the food web and, therefore, any change in microalgae population will have an important effect into the rest of food web. The direct mechanism of NPs toxicity is the physical damage in cell membrane through adsorption of NPs onto the cell wall leading to NPs uptake, bioaccumulation and toxicity in different organelles. Therefore, the hypothesis of our work is that microalgae lacking of cell wall will be more vulnerable to the toxic effects of NPs than microalgae with a typical cell wall. To test this hypothesis two microalgae species, Dunaliella salina, lacking cell wall, and Chlorrella autotrphica, with a typical cellulosic cell wall were chosen. Species were exposed to (AgNO₃ and Ce(NO₃)₃) and NPs (Ag NPs and CeO₂ NPs) forms of Ag and Ce over 72 h and the following responses were assessed: cell density, cell viability, cell size, cell complexity, autofluorescence of chlorophyll a, active chlorophyll, effective quantum yield of photosystem II and reactive oxygen species (ROS). Metals in both forms (NPs and ionic) caused negative effects in cell division, inherent cell properties and physiological mechanisms of both microalgae. The general trend was a decrease in active chlorophyll, effective quantum yield of PSII, and cell density and an increase in cell complexity and percentage of intracellular ROS. For both microalgae species, Ag was more toxic than Ce and ionic forms of both metals were more toxic than NPs. Contrarily to our hypothesis, D. salina, despite not having a cell wall, showed to be less sensitive to metals than C. autotrphica. Therefore, the cell wall of C. autotrphica seems not to suppose higher protection preventing toxicity of NPs. The higher resistance of D. salina against the metals and metallic NPs tested might be related to: (i) its ability to stock NPs, the measured z-averages ranging from 600 nm (CPO-27-Ni) up to 8 µm (HKUST), Zn-CPO, FeBTC-JM-AR and CPO-27-Ni are investigated in relevant environmental test media. Furthermore, we study the dissolution of metals and other elements from NPMs in test media, and their contribution to the observed effects on R. subcapitata. Particle size measurements showed that the NPMs have a primary particle size between 200 nm and several micrometres. In freshly sonicated stock solutions, the measured z-averages ranged from 600 nm (CPO-27-Ni) to 8 µm (HKUST), Zn-CPO and CPO-27-Ni had the highest zeta-potential of -25 and -20 mV respectively, with Al (OH) fumarate and FeBTC-JM-AR featuring a positive surface charge. Uio-66-COOH and HKUST had very weak surface potentials, which was also reflected in their instability in the stock and exposure media. In a first dissolution study, 5 out of 6 materials (100 mg/L) caused an increase in specific surface area of the particles. Both Uio-66-COOH and HKUST, both directly after dispersion preparation and after 72 h incubation period, reflecting the duration of an R. subcapitata standard toxicity test. Most notable releases after 72 h were from Zn-CPO (Zn, 3457 µg/L), CPO-27-Ni (Ni, 235 µg/L) and HKUST (Cu, 143 µg/L). Uio-66-COOH caused a 100 % increase in S in the exposure media, while Al(OH)-fumarate increased Ca and Mn. Potential mode-of-actions, i.e. impact of NPM particles through depletion of dissolved metals. Due to their adsorption properties, the materials also drastically reduced the amount of P in the exposure media, with Uio-66-COOH also decreasing Ca and Mn. Potential mode-of-actions, i.e. impact of NPM particles through depletion of nutrient elements, toxicity of dissolved metals, or effects from organic components will be identified in the R. subcapitata toxicity tests.

Tracking Physicochemical Changes of PAHs in the Presence of TiO2 Nanoparticles by Assessment of Biological Responses
L St Mary, Heriot-Watt University / EGIS; D Patsiou, Heriot Watt University / School of Engineering - Physical Sciences; T.B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society Polycyclic aromatic hydrocarbons (PAHs) are a class of persistent environmental contaminants with diverse physicochemistry and toxicity. In contaminated aquatic environments, PAHs frequently accumulate in sediments or are sorbed to particulates in the aqueous phase. Some PAHs are phototoxic and have photo-induced toxicity, but little is known about interactions between PAH photocactivity, sorption, environmental fate, and toxicity. Engineered nanoparticles (NPs) can behavior as particulate agglomerates that participate in sorption/desorption reactions in the aqueous phase, and some NPs (e.g., TiO₂-NPs) also have photocactivity. Aqueous-phase interactions between PAHs and TiO₂-NPs are of interest because they are becoming more environmentally relevant (i.e., as NPs are increasingly released into the environment), and because investigations of sorption/desorption processes, in the context of photocarboxutiva, can provide important new information on physicochemistry of both PAHs and NPs. Previous work conducted by our research group has found that sorption of PAHs onto photo-active NPs promotes photo-catalysis of PAHs thus altering PAHs bioavailability and toxicity under UV-A radiation. In these experiments, bioavailability (cytotoxicity P4501A cytochrome gene expression in larval zebrafish) is used as an analytical tool to demonstrate sorption of anthrancene and benzo(a)pyrene to NPs in water. Our objective is to investigate PAH/TiO₂-NP sorption under UV-A and the formation of PAH decomposition products (e.g., polyaromatic hydroxyl aromatic hydrocarbons (PAHs) and their bioactivity. Various combinations of PAH/TiO₂-NP preparations will be exposed to UVA, and changes in gene expression of genes involved in Phase I metabolism (cytochrome P4503a and cyp1b1) and Phase II metabolism (gst, egps, gsh; and epoxide hydrolases eph1b and eph2b) in early life stages of zebrafish will be assessed. The exploitation of biological responses (photocatalysis) to investigate changes in PAH and PAH decomposition product bioavailability during sorption processes will provide novel insight into these processes tested directly within the environmentally relevant aqueous phase.
Plastic debris in the marine environment is of particular interest, as the issue is one of a truly global scale. The ubiquitous presence of microplastics and their associated nano-plastics is a widespread issue of engineered nanomaterials is increasing. Landfill of biosolid after wastewater treatment is considered as one of the major input sources of secondary nano-plastics. Its fragmentation process according to exposure duration and sunlight might cause adverse biological effects, however, less research has been done to assess the risk of nanoplastic pollution such as plastic particles is their tissue distribution if ingested by an organism. Therefore, the success of environmental plastic monitoring programs will ultimately depend on the reliability of extraction and detection of plastic particles in tissues of diverse organisms. However, most exposure experiments performed with plastic particles are carried out with unlikely high doses of particles, typically above 1 mg/L while the environmental concentration is expected to be substantially lower. A major influence in altering the bacterial communities associated with MS particles.

**WE414**

**Plastics: does size matter? Impact of environmentally relevant nanoparticles identified in the Nordic environment**

J. Gomes, Norwegian Institute for Water Research (NIVA) / Ecotoxicology and Risk Assessment; A. Lusher, NIVA Norwegian Institute for Water Research / Marine and Freshwater Research Centre; I. Nerlend Bratte, Norwegian Institute for Water Research NIVA; S. Brooks, NIVA / Ecotoxicology and Risk Assessment; A. Macken, NIVA / marine pollution; D. Eidsvoll, Norwegian Institute for Water Research NIVA / Ecotoxicology and Risk Assessment; M. Reid, Norwegian Institute for Water Research NIVA; E. Solfrid Lohne. This work was supported by the Norwegian Research Council and the EU Horizon 2020 project NanoCharm (221391/E40) and NorNanoReg (239199) projects, and the EU NANOREG project grant agreement n° 310584.

**WE412**

**Tracking nanoplastics in marine bivalves at environmentally realistic concentrations**

M. AL SID CHEIKH, University of Plymouth / Marine sciences and engineering; J. S. Rowland, University of Plymouth / School of Geography Earth and Environmental; K. Stevenson, Charles River; C. Roleau, Pesches et Oceans Canada; T. B. Henry, Heriot-Watt University / The School of Engineering, Geoscience, Infrastructure and Society; R. C. Thompson, Plymouth University / School of Marine Science and Engineering.

Awareness campaigns on plastic pollution in oceans are backed by governments worldwide with recent initiatives to ban plastic products such as micro-beads from cosmetics or single-use plastic bags. The fragmentation, the persistence and the production of plastic particles (micro < 1mm, MPs, to nano-size < 1µm, NPs) are among the most prominent environmental issues faced by government environmental agencies. These particles are expected to be a part of a pollutant that is in marine snow (MS) particles. The presence in the environment and any toxic mechanisms are, to a large extent, unknown. In this study, the impact of environmentally relevant plastics identified in Norwegian
environmental samples will be evaluated at the nanoscale in three key marine species, the cryptophyte algae Rhodomonas sp, the harpacticoid copepod Tisbe battagliai and the blue mussel Mytilus edulis and compared to its microscale counterpart. The uptake, accumulation and elimination kinetics of NPLs in the three species will be evaluated under ecologically relevant conditions, as well as their potential transfer along the aquatic food chain. Furthermore, the acute and sublethal ecotoxicological effects of both plastic sizes will be investigated at individual, cellular and molecular levels using different biological endpoints. With the results obtained in this study we aim to discuss the differences in uptake, accumulation and biological responses between different sized plastics identified in the Nordic environment, and consequently bridge the current knowledge gap on the assessment of their potential hazardous effects in marine biota.

WE414 Ecotoxicity of engineered nanomaterials in relation to ecosystem complexity and functioning

W. Peijnenburg, RIVM / Center for Safety of Substances and Products; Y. Zhai, CML Leiden University; M.G. Vijver, CML Leiden University / Conservation Biology & Ecotoxicology

Engineered nanomaterials (ENMs) are widely applied, and the release and accumulation of ENMs through waste effluent and deposition are threaten the aquatic and terrestrial ecosystem. While important knowledge has been gained about the uptake of ENMs on cultured invertebrate and microbial species based on simplified microcosm and mesocosm model systems, extrapolation of results of these tests will be performed at individual level using different biodiversity assemblages (e.g., gut microbiome and the host). Also, the link between microorganisms and invertebrates especially in the aquatic and terrestrial environment is essential in pursuing a realistic risk assessment that accounts for ecosystem complexity and functioning. The take home message is that there is a need of studies assessing not only impacts of ENMs on single species but also a need of a comprehensive framework of nano-specific toxicity in complex ecosystems. Considering the abiotic complexity of the transport of ENMs in the natural environment, studies performed with laboratory-cultured species need to include proper characterization and confident quantification of the environmental factors that impact fate and effects of ENMs. In addition, the biotic complexity in the ecosystem especially in the aquatic and terrestrial environment indicates that risk assessment of ENMs should be conducted in an integral multi-dimensional perspective. For instance, relatively simple studies on uptake and accumulation of ENMs by invertebrate species need to further investigate the perturbation caused by interactions between the intestinal microflora, substances labeled H400, H410, H411, H420) are compared to defined limit values (step 2). The term (14 and 21 days) exposure of P. reticulata to IONPs induced high histopathological indexes associated with circulatory disorders and inflammatory responses with high foci of melanomacrophages indicating an increase of hepatotoxicity according the exposure time. Furthermore, guppies exposed to IONPs showed increasing in the number of MMC when compared to the unexposed ones. This is a first study about hepatotoxicity of IONPs in guppies. The results indicated that the hepatotoxicity estimated by qualitative parameters and histopathological index are important biomarkers to indicate the animal health and the environmental impact of IONPs. The present study confirming that the guppy P. reticulata is a suitable model to test the hepatotoxicity of IONPs. Keywords: Nanomaterials; biomarkers; nanoecotoxicology; guppy. Session: Ecotoxicology and human toxicology: from molecules to organisms, from omics to in vivo (Fish model species in human and environmental toxicity) Presentation preference: Poster presentation

(Eco)toxicity tests for hazard evaluation of recycling materials and waste (P)

WE418 Biotests for Hazardous Waste Classification (H14): benchmarking Limits for Tolerable Ecotoxicity.

B. Welschen, VITO / ABS; E. Rossi, OVALM; G. vanermen, VITO; K. Tirez, Flemish Institute for Technological Research VITO

The current H14 classification is based on the chemical composition of the waste: i.e. the sum of the concentrations of individual chemicals with ecotoxic properties (substances labeled H400, H410, H411, H420) are compared to defined limit values (CLP). In the case of complex waste materials however the analytical data are not sufficient to perform a chemical classification. Therefore a biotest is performed with the chemical evaluation as step 1 biotests in steps 2 (acute aquatic tests on eluate fractions) and step 3 (acute terrestrial tests on solid waste). Limit values are needed for tolerable ecotoxicity (TE) that are in line with the chemical limit values (step 1). In the study presented here we benchmarked biotest results against waste materials that were proven to be toxic in step 1, and it was conclusion that LID4 as TE was a suitable option for our data set. The main conclusions were: The proposed set of biotests is essential for proper H14 evaluation. Poor mass balance in the chemical data should be the trigger for the additional use of biotests. LID 4 is proposed as TE

from a Lake Dosed with Nanosilver

C.D. Metcalfe, Trent University / Water Quality Centre; V.V. Yargeau, McGill University / Chemical Enineering; K. Newman, J.D. Martin, Trent University / Water Quality Centre

Bench-scale tests have shown that silver (Ag) accumulates in the tissues of fish exposed to silver nanoparticles (AgNPs). However, these experiments cannot replicate the complex biogeochemical processes and trophic interactions in natural aquatic ecosystems. This study was conducted as part of whole lake addition project in which a total of 15 kg of AgNPs was added over two ice-free field seasons to a small lake (i.e. Lake 222) in the Experimental Lakes Area in Canada. Both yellow perch (Perca flavescens) and northern pike (Esox lucius) accumulated Ag in their tissues. The greatest bioaccumulation was observed in the liver tissues of pike, and a smaller amount of Ag accumulated in pike and perch muscle tissues. The results observed in liver of 5.1 µg/g wet weight. In perch, the highest concentrations of Ag were observed in gill tissue. Monitoring in the lake using passive sampling devices and single particle ICP-MS confirmed that Ag nanoparticles were present in the water column and that Ag was distributed throughout the lake at estimated concentrations in the range of 1-11 µg/L. These data indicate that the primary mode of Ag bioaccumulation in perch was probably through the uptake in the gill, whereas pike probably accumulated Ag from the diet. The transfer of Ag from forage fish to piscivorous fish can occur in natural lake ecosystems, leading to concentrations in some tissues that are orders of magnitude greater than the concentrations in water.

WE417 Hepatotoxicity of iron oxide (magnetite) nanoparticles in the guppy Poecilia reticulata

G. Qualhato, Federal University of Goias / Department of Morphology; T.L. Rocha, University of Algarve / CIMA; S.M. Saboia-Moraes, Federal University of Goias / Department of Morphology

Although there are many applications of iron oxide nanoparticles (IONPs) in the nanomedicine and nanomaterials, its ecotoxic effects to aquatic organisms remains unclear. In this study, the hepatotoxic effects induced by citrate-functionalized IONPs at environmentally relevant iron concentration (0.3 mg L⁻¹) were investigated in female guppy Poecilia reticulata by histopathological approach based on qualitative analysis and histopathological index after acute and long-term exposure. The animals were collected at the beginning of the experiment and after 3, 7, 14 and 21 days of exposure. TEM results demonstrate crystalline and rounded IONP with an average size of 3.97 ± 0.85 nm, and DLS and ELS analysis showed that the IONPs have low hydrodynamic diameter and high surface charge in ultrapure water (14.11 ± 0.2 nm; -51.1 ± 7 mV) compared to reconstituted water (21.4 ± 0.39 nm; -19.5 ± 6.5 mV). Histopathological results showed an increase in the frequency of histopathological changes in fish after the 7 days of exposure to IONPs, such micro- and macro-steatosis, melanomacrophage aggregates, exudate and hemorrhagic foci. The acute (3 and 7 days) and long-term (14 and 21 days) exposure of P. reticulata to IONPs induced high histopathological indexes associated with circulatory disorders and inflammatory responses with high foci of melanomacrophages indicating an increase of hepatotoxicity according the exposure time. Furthermore, guppies exposed to IONPs showed increasing in the number of MMC when compared to the unexposed ones. This is a first study about hepatotoxicity of IONPs in guppies. The results indicated that the hepatotoxicity estimated by qualitative parameters and histopathological index are important biomarkers to indicate the animal health and the environmental impact of IONPs. The present study confirming that the guppy P. reticulata is a suitable model to test the hepatotoxicity of IONPs. Keywords: Nanomaterials; biomarkers; nanoecotoxicology; guppy. Session: Ecotoxicology and human toxicology: from molecules to organisms, from omics to in vivo (Fish model species in human and environmental toxicity) Presentation preference: Poster presentation

(Eco)toxicity tests for hazard evaluation of recycling materials and waste (P)

WE416 Trophic Interactions in the Bioaccumulation and Depuration of Silver in Fish

E. Battaglia, Hanyang Univ. / Regulatory Chemical Analysis & Risk assessment Center; S. ok, Kitetch / Regulatory Chemical Analysis & Risk assessment Center; M. Song, J. Ra, Korea Institute of Industrial Technology

Most of available mobile lab developed and operated in Korea are air quality monitoring system and there is no rapid reacting mobile lab responding chemical accident of aquatic environment in Korea. Development of rapid reacting automatic mobile lab responding chemical accident of aquatic environment in Korea is needed. Vibration testing shakers are established. Vibration information of a vehicle by exposure conditioning system to control our target chemicals, which was composited onto COMBI type filter. The take

WE415 Development of rapid reacting automatic mobile lab responding chemical accident of aquatic environment in Korea

H. PARK, Hanyang Univ. / Regulatory Chemical Analysis & Risk assessment Center; S. ok, Kitetch / Regulatory Chemical Analysis & Risk assessment Center; M. Song, J. Ra, Korea Institute of Industrial Technology

Most of available mobile lab developed and operated in Korea are air quality monitoring system and there is no rapid reacting mobile lab responding chemical accident of aquatic environment in Korea. We designed rapid reacting mobile lab with two major factors, 24hr operating and rapid starting within 1hr after arrival. We also considered system stability during transportation and accessibility to target river or stream, where we collected vibration information of a vehicle by exposure to target river and raised spot of a road and reduced speed. Vibration information assessment were conducted with vibration testing shaker. We also collected topographical information related to diverse accessibility characteristic to river by conducting sampling at the selecting sampling point. Lastly, we adopted special air-conditioning system to control the system contamination from exposure to vaporized chemicals at the accident location. We adopted dual power supply system with 3.5kVA backup and raised spot of a road and reduced speed. Vibration testing shaker is established with vibration information collected. Activated carbon proved to be most effective to control our target chemicals, which was composed onto COMBI type filter. These findings will be modulated and structured to maximize system stability. [keyword] chemical accident, mobile lab, rapid monitoring system.
for steps 2 and 3 (to be further evaluated for a larger data set). Both aquatic and terrestrial tests are needed for complete HP14 evaluation. This study was funded by OYAM, the Flemish Waste Agency/ The kind help of the technicians Guy Geukens, Cis Boonen, Wilfried Dumortier is highly appreciated.

WE419
What is the future for the waste wood in terms of ecotoxicological testing? S. Legay, FCBA / Chimage Ecotoxicology Lab, C. Martin, FCBA / Gironde In Europe, the classification of waste is carried out by an assessment of the hazardousness of the waste using data of known waste composition according to the properties of danger. This classification can be based only on the waste composition if the available data are sufficient and relevant. This method is based on the sum of contributions of each waste class with CLP (Classification, Labelling, Packaging) regulation [European regulation [EC] 1272/2008]. In the majority of cases under complex mixtures, or of unknown nature (e.g: exterior and interior joinery, furniture, panels, wooden paneling, wood flooring, construction waste and demolition...) including wood preservative, paints, glues, the characterisation of their wastes is considered to be difficult. Eco-toxicological testing seems to be the most relevant because the effects of all contaminants (synergistic effects, additives and antagonists) are integrated. It is a major advantage in the characterisation of waste. In this case, the waste has to be then subjected to a battery of bio tests (aquatic and terrestrial) in order to evaluate one of the 15 existing properties: Eco-toxicity for the environment (HP14). Test strategies will allow wood wastes to be recovered or recycled.

WE420
QUALITY STANDARDS FOR URBAN WASTE FERTILIZERS: PUTTING ECOTOXICOLOGY IN THE PICTURE S. Cheliño, CFE / Centre for Functional Ecology / Department of Life Sciences of University of Coimbra; C. Venâncio, Department of Biology / Biology; J. Lopes, University of Aveiro / Department of Biology & CESAM; 3810-193 Aveiro; J. Sousa, University of Coimbra / Department of Life Sciences
The recently adopted EU Circular Economy Package intends to boost the production and EU movement of fertilizing products, such as those obtained from urban wastes (UWF) and the harmonization of quality standards (certification) for such products, to avoid market rejection. The Portuguese and EU regulation on UWF production/commercialization relies only on physico-chemical/biochemical analysis, which do not give any insight on the fraction of contaminant/mixture of contaminants bioavailable for organisms, nor the existence of potential antagonistic and/or synergistic effects. The main objective of this study is to develop an environmental quality certification system for the use of UWF in agricultural systems. In the present contribution, it was intended to characterize the ecotoxicological potential of the selected UWF, by evaluating both soil habitat and retention functions using lower-tier laboratory tests. Five UWF, two with origin in source separated organic wastes (group I, theoretically with higher quality, ex. lower metal content) and three originated from the organic fraction of mixed municipal solid waste (group II) were selected and tested using a battery of standardized ecotoxicological assays with plants, soil invertebrates and freshwater species. Five soil-UWF dilutions (0.7; 2.1; 6.3; 18.9; 56.7%) and eluates of pure UWF were used as test-medium. The results show that the highest and lowest toxicity were observed in the two UWF from group I. Among soil organisms the range of sensitivities was: E. andrei > F. candida > E. crypticus > L. sativa > T. aestivum while for aquatic organisms was: H. viridissima > R. subcapitata > C. vulgaris > H. incongruus > B. calyciflorus. The observed toxicity was probably related with UWF high salinity rather than with metal contents. The obtained data also reinforce the need to include information from biological susceptibility of the receptors potentially at risk on the available regulation to obtain a more realistic view of the potential risks and to adapt the UWF application practices. Ultimately, a sustainable economic growth based on the efficient use of resources/waste valorization can be promoted.

WE421
Chemical and Ecotoxicological Assessment of Reclaimed Asphalt for their Subsequent Use V. Jandova, C. Martin, E. andrei, C. Martin, FCBA / Chemistry Ecotoxicology Lab, C. Martin, FCBA / Gironde
Stormwater sources are difficult to understand because of the poor characterization of the irregular, event-driven inputs and the difficulty of managing diffuse sources of large volumes of runoff. The study objective is to develop methodologies to quantify the consequences of ongoing low-level sources on chemical concentrations, contaminant availability, and effects on biological receptors in surficial sediments. The study area was in Paleta Creek near Naval Base San Diego (NBSD), in California. Two storm-events were captured for particle size characterization and chemical analysis. Receiving and outfall waters collected using auto-samplers, which were triggered at each location during two different seasons. The samples were analyzed for a variety of metals, PAHs, and PCBs, as a function of particle size. Sediment traps and sediment cores were also collected from the Creek and subjected to bulk chemical analysis. The fractionated water and sediment samples were processed for metal extraction using the modified EPA method 3050 A and 3050B, respectively. The metals were analyzed using ICP-MS and MERX-T. Persistent organic pollutants in water samples were Liquid-Liquid Extracted (LLE) using the modified EPA Method 3510C, while sediment was extracted by Pressurized Fluid Extraction (PFE with ASE 350) using the modified EPA Method 3545A. PAH analysis was performed on HPLC and PCBs on GC/MS. Results showed that storm-events were dominated by coarse particles initially most likely to lead to sediment recontamination in the near field of the receiving water (e.g., PAH, and Cd). Cu was associated to the dissolved and clay fraction, however the depositing loads were more influenced by resuspension and redistribution of sediment than stormwater. Data suggested that PAHs and PCBs, due to low bioavailability as determined with passive sampling and bioaccumulation testing, are not a strong contributor to sediment toxicity which appeared to be better correlated to the presence of pyrethroids in the traps. The results indicated that the size-segregated contaminant loads and simultaneous receiving water measurements were very helpful in relating the stormwater discharges to sediment recontamination. The particle associations in stormwater along with spatial distribution particularly in sediment traps, and less in the sediment cores, can identify contributing locations, effective remedial approaches, and help to propose best practices for stormwater and sediment management.

WE422
Construction products and waste materials used for construction can be in contact with the environment and may release potential harmful compounds. Information on the total content of these substances in the product is not sufficient to assess its environmental impact since it does not consider realistic exposure conditions. Concerning the pathway to soil and groundwater by contact with rain or seepage water leaching tests are available. The aim of this presentation is to show exemplary results of existing leaching methods and underline the strength and weaknesses of this kind of test with selected examples of our work: Concrete roofing tiles with terbutryn were leached according to CEN/TS 16637-2 with permanent immersion into water and according to EN 16105 with nine immersion cycles each consisting of immersion and dry stages. The eluates were divided into subsamples for different parameters as pH, conductivity, total organic carbon, anions, cations and terbutryn. Concerning the assessment of this leaching data it is important to notice that the eluate concentration do not represent necessarily environmental concentrations. Thus, the concentration in the leaching test cannot simply be considered to limit values in environmental or construction use. Further considerations are necessary including exposure scenarios and environmental pathways before leaching tests can be used in risk assessment.

Advances in monitoring and evaluating remedy effectiveness for in situ amendments in soils and sediments (P)

WE423
Assessment and management of stormwater on sediment recontamination: you don’t need to measure everything, just the right things I. Drygiannis, Texas Tech University / Department of Civil Environmental and Construction Engineering; B. Steets, UTSA / Department of Civil Environmental and Construction Engineering; M. Bejar, Texas Tech University; M. Rakowska, Texas Tech University / Civil and Environmental Engineering; D. Athanasiou, Texas Tech University / Civil, Environmental, and Construction Engineering; D. D. Rebble, Texas Tech University / Civil and Environmental Engineering; G. Burton, University of Michigan / School for Environment and Sustainability; G. Rosen, Texas Tech University / Marine Science Center; C. Martin, FCBA / Chemistry Ecotoxicology Lab; C. Martin, FCBA / Gironde
Stormwater sources are difficult to understand because of the poor characterization of the irregular, event-driven inputs and the difficulty of managing diffuse sources of large volumes of runoff. The study objective is to develop methodologies to quantify the consequences of ongoing low-level sources on chemical concentrations, contaminant availability, and effects on biological receptors in surficial sediments. The study area was in Paleta Creek near Naval Base San Diego (NBSD), in California. Two storm-events were captured for particle size characterization and chemical analysis. Receiving and outfall waters collected using auto-samplers, which were triggered at each location during two different seasons. The samples were analyzed for a variety of metals, PAHs, and PCBs, as a function of particle size. Sediment traps and sediment cores were also collected from the Creek and subjected to bulk chemical analysis. The fractionated water and sediment samples were processed for metal extraction using the modified EPA method 3050 A and 3050B, respectively. The metals were analyzed using ICP-MS and MERX-T. Persistent organic pollutants in water samples were Liquid-Liquid Extracted (LLE) using the modified EPA Method 3510C, while sediment was extracted by Pressurized Fluid Extraction (PFE with ASE 350) using the modified EPA Method 3545A. PAH analysis was performed on HPLC and PCBs on GC/MS. Results showed that storm-events were dominated by coarse particles initially most likely to lead to sediment recontamination in the near field of the receiving water (e.g., PAH, and Cd). Cu was associated to the dissolved and clay fraction, however the depositing loads were more influenced by resuspension and redistribution of sediment than stormwater. Data suggested that PAHs and PCBs, due to low bioavailability as determined with passive sampling and bioaccumulation testing, are not a strong contributor to sediment toxicity which appeared to be better correlated to the presence of pyrethroids in the traps. The study indicated that the size-segregated contaminant loads and simultaneous receiving water measurements were very helpful in relating the stormwater discharges to sediment recontamination. The particle associations in stormwater along with spatial distribution particularly in sediment traps, and less in the sediment cores, can identify contributing locations, effective remedial approaches, and help to propose best practices for stormwater and sediment management.

WE424
Development of active capping materials for oil spill contaminated sediment remediation L. Akesson, Norwegian Geotechnical Institute; P. di palma, IRSA/CNR; C. Riccardi, INAIL; E. Ezek, s.e. hale, Norwegian Geotechnical Institute; p. viotti, Università La Sapienza; M.P. Papini, Università La Sapienza / Chemistry
Petroleum is extensively used for making oil-based chemical and energy; its daily
consume is on average 20 million tons and this is not predicted to decrease. The increasing use of the petroleum is inevitably connected to an increase in oil spills. Oil spills can occur for many reasons including human error or equipment failure and whenever an oil spill occurs it can represent a worldwide environmental problem. Effective remediation strategies are required. The aim of this study is to develop different sorbent materials for the active capping of oil spill contaminated sea-sediment. The experimental investigation was performed on an oil spill contaminated sediment. Different sorbent materials were tested for the active capping: a commercial Activated Carbon (AC) Carbonitalia, an organophilic clays (OC) CETCO Inc. and a biochar (BC). The sorption properties of the materials were first investigated in aqueous solution by performing equilibrium tests (isotherm) using a mixture of polymeric aromatic hydrocarbons (PAHs) as target contaminants. The bioavailable concentration was assessed by using polyethylene (PE) (26 µm) passive samplers. Capping experiments were performed in glass cylinders, where a layer of contaminated sediment (7.5 cm) was capped with a layer of 3 cm of sand mixed with the different tested materials (AC, OC and BC) and synthetic sea water (4 cm) on top. The capping efficiency was assessed by using polydimethylsiloxane (PDMS) fibers as passive samplers. The PAH profiles in the different capping systems were compared in order to assess the capping efficiency. Biochar showed a greater capping efficiency than activated carbon and organoclay. For example, anthracene porewater concentrations in the first centimetre of capping material, were reduced by 69%, 56% and 99% respectively for activated carbon, organoclay and biochar after 1 month. The porewater concentrations were also used to model the long term (>12 months) behaviour of various cap configurations with a numerical simulator. Measurements were used to determine that biochar can be considered a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

**WE425**

**Pb and Zn Tissue Concentrations and Benthic Community Impacts at a Carbon Amendment Pilot Study in the Intertidal and Subtidal Zones of San Francisco Bay**

C.J. McCarthy, CH2M / Environmental Services; C.A. Irvine, RBI / Ecosystem Services; T. Himmer, CH2M; S. Clark, Pacific EcoRisk; R. Zajac, J. Eby, CH2M

Historical site activities at the Hunters Point Naval Shipyard (HPNS) in South San Francisco Bay resulted in the release of chemicals, including polychlorinated biphenyls (PCBs), to offshore sediments. To inform remedy selection at this urban site, activated carbon (AC) amendments were evaluated in a pilot treatability study. Two 0.4 acre plots extending from the intertidal to the subtidal zone were treated with either AquaGate + PAC™ or Sediment™ to assess their potential to reduce ecological risks associated with PCB-contaminated sediments. Previous studies indicated a need for reducing the bioavailability of PCBs to the benthic nannoplankton (Macoma nasuta) in shallow intertidal sediments when aided by mechanical mixing. This study assessed the effectiveness of AC placements without mechanical mixing in deeper water that is more representative of conditions where full-scale remediation is expected. Bioaccumulation, benthic invertebrate community composition, and chemical analyses were measured over a 9 month period to determine if biochar could be considered an effective alternative to AC. Comparisons were made between baseline, reference, and post-amendment conditions (8 and 14 months post-placement). PCB tissue concentrations in Macoma sp. were measured in situ (field) and ex situ (bench-top) after 28-day exposures. Developing field exposure chambers that allowed sediments to infiltrate the chambers and expose clams upon deployment and then retrieve the sediment and exposed organisms for chemical analyses was a challenge. Modifying a chamber design used in previous studies by Luthy et al. (2009) proved successful. Test organisms were another challenge. Tissue bioaccumulation was planned to be conducted with M. nasuta but instead, initial measurements were made with M. secta (white sand clam) collected at a nearby reference location where M. nasuta had been previously found. The species have a similar appearance and life histories but M. secta had low survival in the field (<20%), lab exposures (<60%), and lab controls (10%). Additional field pilot testing led to the use of M. nasuta from a supplier for post-amendment monitoring. PCB tissue concentrations were reduced by up to 85% in both pilot amendment areas after 14 months with clam survival greater than 90%. Benthic invertebrate communities in test plots were not significantly different from baseline conditions or treatments for 14 months after AC deployment.

**WE426**

**Remediation of mine wastes with biochar: effect on metal bioavailability to earthworms**

M. Almira-Casellas, Leitat Technological Center / HEHS; V. Gonzalez, M. Diez-Ortiz, Leitat Technological Center

The impact of two biochar-based amendments (one from pruning trees and other from sewage sludge) in metal toxicity and bioavailability was assessed in an acid (A) and an alkaline (B) mine waste before and after incubation under different simulated field conditions (irrigation versus drying periods). Metal CaCl₂-extractable fraction, survival and metal tissue concentrations in the earthworm Eisenia fetida exposed to bulk (mine wastes) were measured. Survival of E. fetida was recorded after 21 days of exposure to six serial dilutions of mine wastes mixed with uncontaminated Lufa 2.2 natural soil containing waste concentration of 100, 50, 25, 12.5, 6.25 and 3.13% (w/w), and internal tissue metal concentration in surviving earthworms were measured. No signs of toxicity and no significant effects on survival of the organisms were observed in alkaline mine waste B. In contrast, exposure at time 0 to untreated acid mine waste (A) caused a 71% of mortality. The addition of biochars decreased toxicity in mine waste A and Cd internal concentrations in surviving organisms, indicating a lower metal bioavailability. Over time, survival in the untreated acid mine waste increased and internal total body metal concentrations in earthworms showed a decreasing trend. This study assessed the potential to reduce ecological risks associated with PCB bioaccumulation and the consequent decrease in organisms’ body metal bioaccumulation.
**WE429**

Identification, Quantification, and Risk Assessment of Polycyclic Aromatic Hydrocarbons and their Polar Derivatives in Soil After Steam Enhanced Extraction

L.S. Time, Oregon State University / Chemistry / Environmental and Molecular Toxicology; E. Lee, Oregon State University / Environmental Protection Agency / Ground Water & Ecotemns Restoration Division; S.L. Massey Simonich, Oregon State University / Department of Environmental and Molecular Toxicology

Polycyclic aromatic hydrocarbons (PAHs) are environmental contaminants produced from the incomplete combustion and pyrolysis of organic matter, and are among the major contaminants in soils. Steam enhanced extraction (SEE) is an in situ thermal remediation technique that uses the addition of steam to soil to increase the subsurface to increase the removal efficiency and recovery of volatile and semi-volatile contaminants, like PAHs. However, there is limited research on the formation of PAH derivatives during SEE of PAHs. Polar PAH derivatives are more mobile in the environment than PAHs, and some are more toxic than corresponding PAHs. There is an urgent need for analytical methods that can accurately quantify PAH derivatives in complex matrices, to better understand the chemistry occurring during SEE, and how it interferes with the remediation of soils.

In this study creosote-contaminated soil from the Wyckoff/Eagle Harbor Superfund Site in Washington, USA was thermally treated with laboratory-scale SEE. Soil pre- and post-SEE, effluent collected during SEE, and pre- and post-SEE leachate samples (mimicking rain runoff and groundwater) were collected and analyzed with gas chromatography-mass spectrometry (GC/MS) for PAHs, polar PAHs, and MW302-PAHs (n=97). Most of analyzed PAHs were quantified in all pre-, post- and effluent samples. PAHs decreased significantly, while polar PAHs increased in mean concentration post-SEE soil. Mass balances were estimated for different PAHs, and some were above 100%, indicating the potential formation of PAH derivatives during SEE. These findings suggest that SEE pilot and treatability studies should include quantification of PAH derivatives to risk assessments to assess the full effectiveness of SEE and prevent underestimation of potential risks. A quantitative risk assessment will be performed by calculating B[a]P, concentrations and estimated lifetime cancer risk (ELCR) ingestion estimates. Developmental toxicity testing will be conducted with dechorionated zebrafish (Danio rerio) embryos (n=32/treatment) placed into 96-well plates containing pre- and post-SEE soil, effluent, and pre- and post-leachate extract samples at 6 hours post fertilization. Developmental toxicity will be assessed by evaluating morphological changes, embryonic/larval photomotor behavior, and mortality at 24 and 120 hours post fertilization. This study quantified PAH derivatives after SEE, and it will identify implications for risk assessment and developmental toxicity outcomes.

**WE430**

Enhanced total petroleum hydrocarbon removal without soil disturbance by serial surfactant foam spraying

R. Bajagain, Y. Park, Kunsan National University / Department of Environmental Engineering; S. Jeong, Kunsan National University / Department of Environmental Engineering

Fuel spills are a common environmental problem. Polynuclear hydrocarbons are readily biodegraded in the natural soil system. Diesel includes recalcitrant hydrocarbons to the natural degradation and may act as potential and actual sources of harmful human and ecological effects. The purpose of the study was to evaluate serial surfactant foam spraying technique, which avoids disturbing the soil, to deliver chemical oxidant and oil-degrading microbes to unsaturated soil. Hydrogen peroxide was used as a hydrogenation and reductive biodegradation. All oxidants were applied to the surface soil by surfactant foam spraying. Surfactant foam would be a good media to spread remediation agents to the surface of contaminated sites with less labor or energy. Surfactant foam was sprayed once onto diesel contaminated soil for oxidation of total petroleum hydrocarbon (TPH). Periodic biodegradation foam was sprayed every three days for biodegradation of soil TPH. Foam spraying employing oxidation-bioaugmentation serial application significantly reduced soil TPH concentrations to 550 mg/kg from an initial 7470 mg/kg. Application of hydrogen peroxide by foam spraying increased the infiltration of hydrogen peroxide into the unsaturated soil. The easy and even infiltration of remediation reagents increased the contact with contaminants, resulting in enhanced oxidation and biodegradation. Fractional analysis of TPH showed C18-C22 present in diesel as biodegradation recalcitrant hydrocarbons. Recalcitrant hydrocarbons were reduced by 92% using oxidation-biodegradation serial foam, while biodegradation alone only reduced the recalcitrant fraction by 25%.

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**WE431**

Factors affecting sorption of halogenated phenols to polymer/biomass-derived biochar: Effect of pH, hydrophobicity, and deprotonation

S. Oh, University of Ulsan / Department of Civil and Environmental Engineering; Y. Seo, University of Ulsan / Civil and Environmental Engineering; T. Seo, University of Ulsan / Department of Civil and Environmental Engineering

High performance biochar synthesized via co-pyrolysis of polymer and rice straw (RS) was evaluated as a sorbent for ionizable halogenated phenols. Compared with RS-derived biochar, the sorption of 2,4-dichlorophenol (DCP), 2,4-dibromophenol (DBP), and 2,4-difluorophenol (DFP) to polymer/RS-derived biochar was significantly enhanced by changing properties of biochar due to polymer residues, probably via hydrophobic sorption and electron donor-acceptor interactions. Removal of polymer residues and increasing aromaticity of polymer/RS-derived biochar at elevated pyrolysis temperatures affected the sorption capacity of halogenated phenols. Surface charge of biochar and deprotonation of the halogenated phenols affected the sorption capacity. There were other factors to be responsible for the sorption to polymer/RS-derived biochar. Competition with other halogenated phenols and dissolved cations implied that similar sorption mechanisms were existed and that surface complexation and electron donor-acceptor interactions were involved in the sorption to polymer/RS-derived biochar. Our results suggest that co-disposal of biomass and thermoplastic wastes through pyrolysis may be an effective option to produce a high-performance upgraded biocchar as a sorbent for various types of contaminants.

**WE432**

Biochar for soil management: interactions with legacy contaminants and current-use pesticides

L. Bierkand, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; K. Kročová, Masaryk University / Faculty of Science, RECETOX; L. Skulcova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX)

Biochar (BC) is a product of thermal decomposition of biomass under oxygen-limited conditions. BC has received extensive attention because of its many benefits for gas uptake of chemicals by agricultural soils. Its excellent sorption properties make BC a valuable sorbent in the treatment of solids contaminated with hydrophobic organic compounds (HOC) and wastewater. Due to its assumed stability, BC is considered an environmentally compatible approach for carbon sequestration and thus, climate change mitigation. Its application to agricultural soils has been shown to increase soil fertility, mainly due to improved chemical and physical properties. BC and its constituents improve soil microbial activity, nutrient availability, protection of microorganisms, and increased water holding capacity. Despite these benefits, very little BC is currently utilized as soil amendment, mainly because the mechanisms improving soil health are poorly quantified and understood. Besides, there are several concerns and unknowns for BC agricultural application: i) the presence of pollutants (HOC, heavy metals) originating in pyrolysis or feedstock; ii) lower specific density resulting in transport of BC and BC-associated pollutants into surface water bodies; iii) substantial reduction of efficacy of agrochemicals; iv) effect of BC stability during weathering on its application potential, particularly long-term fate of agrochemicals. In this study, the role of BC in the management of contaminated soils and in the management of pesticide-treated agricultural soils is addressed. A systematic approach is devoted to the positive effects of reduced bioavailability of toxic contaminants and the ambiguous effects of reducing bioavailability of intentionally applied current-use pesticides. For that purpose, two different biochars were applied at increasing doses to soils amended with DDE and with epoxicoxazole and tebuconazole as representative of legacy contaminants and broadly used fungicides, respectively. Bioavailability was assessed by means of solid-phase microextraction as well as functional bioavailability using earthworms. Biochar was applied to contaminated soil as a model ecotoxicologically relevant organism. The influence of biochar properties and biochar dose was considered. At the same time, the well-being of earthworms in biochar-amended control soils was detected. This study aimed at balancing the dosing of biochar in soil management to ensure both an efficient and sustainable control of diffuse contamination and of pests.

**WE433**

PREPARATION AND CHARACTERIZATION OF COMPOSITES OF TYPE CLAY / POLYMERS AND THEIR USE IN THE REMOVAL OF CONTAMINANTS ORGANICS OF AQUATIC ENVIRONMENTS.

M.S. Rodrigues, Instituto Federal do Maranhão; L. Aquino Vieira, Universidade Federal do Maranhão; A. Costa Filho, S.G. RIBEIRO, Universidade Federal do Maranhão

Clays have been used by mankind to many years due to its easy to obtain, its high technical viability rate and low economic cost. Among countless uses for the clay, research related to its various properties and also the adsorption capacity of this material has gained prominence among scientists in recent years. Availability determination and/or activation of these properties can be improved, resulting in a direct increase in the adsorption rate. The changes made in the samples of clays of this work were made from 2,6-bromonionenone polymer, the process of cation exchange, which generated organophilic characteristics for samples, allowing comosaorventes of organic compounds were used. Serious damage to fauna and flora are caused by the use of phosphate and hydrophobic compounds, this leads to search for new methods aimed at removing it mainly aquatic environment. Given that the application of this work aims at the preparation and characterization of organophilic clays, as well as to evaluate its adsorption rate of these compounds organics. Para it was used a natural clay from the Carolina-MA region. infrared techniques, X-ray diffraction, scanning electron microscopy (SEM), mass determination tests adsorbent and determining the concentration of contaminants were used to characterize the samples. At the end of the process it was noticed a structural modification of the clay shown in SEM, but also the vibrational result given by the infrared showing major carbon chains present in the composite nano derived polymer, it caused a significant increase of
adoption capacity the material was 40% in nature, reaching a value of 78.4% after modification, deteriorating the feasibility of the process and material.

WE434
Field sampling and ex-situ bioassays for assessing the ecotoxicological risk of trace elements in different rehabilitated bauxite residues
E. Di Carlo, R. Courtney, University of Limerick / Department of Biological Sciences & The Bernal Institute; A. Boulemtant, RíoTinto; L. Poizat, Alteo-Alumina
Bauxite residues are the by-product of the aluminium industry, resulting from the extraction of alumina from bauxite ore through the Bayer process. They could pose an environmental risk mainly because of their alkaline nature and the presence of trace elements (TE). For their rehabilitation and phytostabilization, using PHB seems to be a promising, cost-effective and non-resource intensive option. However, there are still few studies evaluating the long-term success of the rehabilitation programmes and most of them do not consider ecotoxicology. The present study aims at assessing the success of rehabilitation strategies for bauxite residues considering the ecotoxicological risk of TE to organisms that live in the rehabilitated areas. To this end, two approaches were adopted: field sampling and ex-situ bioassays. On the one hand, samples of bauxite residues, plants and soil macroinvertebrates were collected from a range of field sites, over different seasons, and the environmental concentrations of TE were measured through ICP. On the other hand, exposure tests with earthworms (following OECD guidelines) and RHIZOtest (ISO 16198) with three herbaceous species were carried out, under controlled laboratory conditions, in order to investigate the bioavailability of TE. Data from the field represent the first step to understand whether there is a possible ecotoxicological issue for wildlife. Comparing the TE concentrations measured in the environment with the literature thresholds, some problematic elements (such as V) and sites (such as the one with compost capping) are identified. Regarding the laboratory bioassays, data show that the bioavailable fraction (taken up and accumulated by both plants and earthworms) does not always correlate with the concentrations measured in the extractions of the bauxite residues, indicating the inadequacy of chemical methods when comes to evaluate the ecotoxicological risk. In conclusion, the outcomes of this research are likely to shed light on the bioavailability of TE in a complex matrix, such as bauxite residues, and to provide a more realistic risk assessment for the organisms living there. Our data clearly show that the chemical total concentrations measured in the bauxite residues do not predict the bioavailable (potentially toxic) fraction of the TE, therefore bioassays should be taken into account when fixing the rehabilitation goals or assessing the rehabilitation success of a contaminated area.

Ecotoxicity of micro and nanoplastics: Mechanistic approaches to understand their risk for the environment and human health (P)

TH001
Synthetic textile fibers end up in agricultural soils – Can these microplastics pose a threat on soil organisms?
S. C. Chang, University of Helsinki / Department of Ecological Science; C. Gestel, Vrije Universiteit Amsterdam / Ecological Science
An important route of microplastics (MPs) to the environment is the release of synthetic textile fibers to waste water due to laundry. The major part of the fibers is retained in the sewage sludge during waste water treatment and ends up in green spaces and agricultural fields. In this study, we explored the accumulation and effects of polyester fibers in soil invertebrates following applications of 0.02%, 0.06%, 0.17%, 0.5% and 1.5% of PES fibers in dry Lua 2.2 soil. The fibers were mixed in with the soil to achieve as homogenous mixture as possible. Polyester fibers in soil affected the survival and reproduction of the enchytraeid worm Enchytraeus crypticus, but the effects did not show a consistent dose-related pattern. Compared to the control soil, the survival was decreased at fiber concentrations of 17% and 5%, whilst the reproduction was decreased in all other treatments except for the 0.06% concentration. Polyester fibers did not affect the survival and reproduction of the springtail Folsomia candida and the oribatid mite Oppia nitens, the survival and feeding activity of the woodlice Porcellio scaber, nor the survival of the earthworm Eisenia andrei. Some of the measured endpoints seemed to show a negative response to the fibers, but the variation within the treatments was high, possibly also because it was difficult to achieve a completely homogenous distribution of the fibers in the test soil. The results of this study indicate that synthetic textile fibers can have slight negative effects on soil-dwelling enchytraeid worms, whilst arthropods were not markedly affected by the fibers. However, not only enchytraeid worms (E. crypticus), but also isopods (P. sordidus), the earthworm Eisenia fetida and woodlice Porcellio scaber were affected. The degree of accumulation was not related with the fiber concentration in the soil. As the accumulation of microplastics in soils is evident, the effects of different types of microplastics and their possible role as carriers of xenobiotics to soil organisms need to be further investigated. This study is part of the project IMPASSE – Impacts of Microplastics in Agro Systems and Stream Environment.

Effects of microplastic particles of polyhydroxybutyrate towards photosynthetic aquatic organisms
M.G. Pieles, Universidad Autónoma de Madrid; G. AMARIEL, Universidad de Alcalá; M. Tamayo-Belda, Universidad Autónoma de Madrid; F. Leganes, Universidad Autónoma de Madrid / Biology; R. Rosal, Universidad de Alcalá; F. Fernandez-Pihias, Universidad Autónoma de Madrid / Biology
Nowadays, the ecotoxicological impact of microplastics in freshwater is not well understood [1]. Here, we have investigated the effects of microplastic particles (nominal size 5 mm) of polyhydroxybutyrate (PHB) in two organisms representative of freshwaters, the filamentous cyanobacterium Anabaena sp. SCC7120 and the green alga Chlamydomonas reinhardtii. Firstly, we have performed the physicochemical characterization of microplastic particles of PHB and their potential degradation products and PHB by nanoparticle tracking analysis (NTA), dynamic light scattering (DLS) and infrared spectroscopy (IR). Then, we have evaluated the biological effects of PHB on cellular growth, pigment content and several physiological parameters (metabolic activity, formation of intracellular reactive oxygen species and cytoplasmic membrane) in both photosynthetic organisms by flow cytometry using several fluorochromes. The results indicate that PHB released nanoparticles. NTA allowed to analyze the abiotic depolymerisation of PHB after 72 h in MilliQ finding a wide range (75 - 300 nm) of PHB nanoparticles. PHB induced a decrease in cellular growth and chlorophyll content in both photosynthetic organisms. Furthermore, PHB induced an increase in the level of intracellular reactive oxygen species and induced changes in membrane potential. In conclusion, microplastic particles of PHB exhibited toxic effects by photoprotective effects of MPs and their effect on release of a wide range of nanoparticles as a consequence of its own abiotic depolymerisation.


TH003
Differential responses of biomarkers in tissues of the blue mussel Mytilus edulis exposed to microplastics at environmentally relevant concentrations
M. Revel, Catholic University of the West / UBL, Mer Molecules Sacé; F. Folsom, Department of marine and Environmental Sciences and Biotechnology; M. Fossi, C. Panti, University of Siena / Department of Life Sciences
Debates about environmental impact of microplastics are increasing worldwide. One of the main questions is whether MPs are strongly toxic for marine organisms. The main objectives of this study were to understand whether Microplastics and nanoplastics (MP) are toxic for the Mediterranean mussel, Mytilus edulis. Three groups of MPs were identified as follows: plastic particles (nominal size 5 mm), PHB (nominal size 75 and 300 mm), PP (nominal size 300 mm). The MPs were tested in the laboratory from commercially available products by milling; characterized in terms of size, shapes and they were counted. Following exposure, tissues and biodeposits were extracted of size, shapes and they were counted. Following exposure, tissues and biodeposits were extracted and analyzed (NTA), dynamic light scattering (DLS) and infrared spectroscopy (IR). The results showed that MPs induced significant changes in the concentrations of the measured biomarkers. The results of this study indicate that microplastics and nanoplastics are toxic for marine organisms. The main toxic effects of MPs were observed in digestive glands, mantle and gills. The results of this study indicate that microplastics and nanoplastics are toxic for marine organisms. The main toxic effects of MPs were observed in digestive glands, mantle and gills. The results of this study indicate that microplastics and nanoplastics are toxic for marine organisms. The main toxic effects of MPs were observed in digestive glands, mantle and gills. The results of this study indicate that microplastics and nanoplastics are toxic for marine organisms. The main toxic effects of MPs were observed in digestive glands, mantle and gills. The results of this study indicate that microplastics and nanoplastics are toxic for marine organisms. The main toxic effects of MPs were observed in digestive glands, mantle and gills. The results of this study indicate that microplastics and nanoplastics are toxic for marine organisms. The main toxic effects of MPs were observed in digestive glands, mantle and gills.
Due to the constant increase of plastic use and production, microplastics (MPs) have become a contaminant of serious concern for the marine environment. However, detailed information about biological pathways affected by the exposure to different MP polymers is still lacking, in particular at transcriptome level. The present study focused on the identification of the molecular pathways affected by a chronic exposure of zebrafish (Danio rerio) to different concentrations of a commercial mixture of two environmentally relevant MPs for 20 days. Adult zebrafish were fed daily with dry fish food (control group, N=12) and food supplemented with a mix of pristine high-density polyethylene and polystyrene microplastics (two experimental groups: 0.1 and 1 mg/L, N=12 each). The microplastics dimension ranged from below 25 µm to 90 µm for both polymers. At the end of the exposure period, the liver was dissected and its whole transcriptome analyzed by next generation sequencing technology Illumina HiSeq. In addition, the gastrointestinal tract and the gills were dissected and fixed for histology and immunohistochemistry. The exposure to polyethylene and polystyrene microplastics affected the liver transcriptome in a dose-dependent way, inducing the differential regulation of specific suites of genes. Histological analyses evidenced changes in the inflammatory response occurring at the two mucosal tissues selected for observation. The correlation of histological alterations with differential gene expression will be addressed and discussed. This study provides a comprehensive transcriptomic dataset useful for ecotoxicological studies on other fish species.

TH005 Uptake and Effects of Synthetic and Natural Microparticles in the Shrimp Palemon varians
M. Weiding, University Duisburg-Essen; R. Sabedorov, L. Gutow, Alfred Wegener Institute for Polar and Marine Research
Microplastics (<5 mm) have become ubiquitous in waters. The smaller they are the easier they can be taken up by aquatic organisms. Once ingested they can cause various harmful effects. This study investigated the effects of size of artificial and natural particles on the induction of cellular stress in the Atlantic ditch shrimp (Palaemon varians). The study includes feeding experiments with different sizes of fluorescent microplastic particles, nanosized titanium dioxide particles and silica powder of diatoms as a reference for natural particles. The uptake and distribution of particles in the digestive gland was observed by fluorescence microscopy. As marker for oxidative stress we measured the activities of the antioxidant enzymes catalase and superoxide dismutase (SOD) in extracts of the milled glands of animals which were fed with particles from 2 to 48 hours. The larger particles (2 µm and 10 µm) remained in the stomach and in the lumen of the gut. The smaller particles (0.1 µm) were translocated into the stomach and into the midgut gland. Decapods have a stomach with fine-meshed filter structures which prevent the uptake of particles > 170 nm into the digestive gland. Superoxide dismutase activity was rapidly induced when the animals were exposed to 0.1 µm plastic particles. The activity increased within 2 hours after microplastic ingestion and remained high after 48 hours. Slight difference appeared between natural and synthetic particles. The diatom powder also induced SOD activity which, however, continuously decreased with time. Due to the enzyme cascade where SOD reacts first, the activity of catalase was clearly lower. It can be assumed that any particles < 170 nm enter the cells of the midgut gland and induce oxidative stress. Following optical detection of reactive oxygen species (ROS) via confocal laser scanning microscopy will help to identify cellular reactions after exposure to microparticles.

TH006 Microplastics in the sub-surface layers of the South Atlantic Ocean V. van der Schyff, North-West University / Unit for Environmental Sciences and Management; J. Karstensen, GEOMAR
The present study focused on the identification of the molecular pathways affected by a chronic exposure of zebrafish (Danio rerio) to different concentrations of a commercial mixture of two environmentally relevant MPs for 20 days. Adult zebrafish were fed daily with dry fish food (control group, N=12) and food supplemented with a mix of pristine high-density polyethylene and polystyrene microplastics (two experimental groups: 0.1 and 1 mg/L, N=12 each). The microplastics dimension ranged from below 25 µm to 90 µm for both polymers. At the end of the exposure period, the liver was dissected and its whole transcriptome analyzed by next generation sequencing technology Illumina HiSeq. In addition, the gastrointestinal tract and the gills were dissected and fixed for histology and immunohistochemistry. The exposure to polyethylene and polystyrene microplastics affected the liver transcriptome in a dose-dependent way, inducing the differential regulation of specific suites of genes. Histological analyses evidenced changes in the inflammatory response occurring at the two mucosal tissues selected for observation. The correlation of histological alterations with differential gene expression will be addressed and discussed. This study provides a comprehensive transcriptomic dataset useful for ecotoxicological studies on other fish species.

TH007 Effects of dietary microplastic exposure on fish intestinal physiology G. Asmonaite, H. Sundh, N. Asker, University of Gothenburg / Department of Biological and Environmental Sciences; B. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences
The accumulation of plastics in digestive tracts of aquatic biota has been extensively documented and ingestion has been proposed as a prominent exposure route for plastic debris for a variety of organisms, including fish. Large plastic items are known to physically block the intestinal passage, exert physical damage, impair food uptake and/or cause false satiation. Whereas, the biological effects resulting from ingestion of smaller micro-sized particles or microplastics (MPs) are considerably less documented and potential (negative) consequences on the alimentary tract are largely unknown. To address this, we designed a study aimed at assessing if/how ingestion of MPs can affect physiological function of the intestine in fish. We hypothesized that ingestion of MPs cause inflammatory responses and disturb intestinal barrier and transport functions. Juvenile rainbow trout (Oncorhynchus mykiss) were exposed via diet to polystyrene (PS) particles (50-250 µm, 10mg of PS MPs/fish/day) for a period of 4 weeks. Fish were fed four types of diets: control (no PS MPs) and diets containing untreated PS particles (PS-virgin) or particles exposed to sewage (PS-manufactured). To detect the presence of systemic inflammation, the inflammatory response (lysozyme stability and complement system) in blood plasma was evaluated. Overall morphology was observed using histology. Gene expression analysis of immune related genes (TGFβ, TNFα, IL-8, IL-10, IL-17, IL-4/13A) and tight junction proteins (Occludin, ZO-1, Tricellulin) was performed to examine if PS particles and chemical contaminants induced inflammation in intestinal tissue. The innate immune response was addressed and discussed. This study provides a comprehensive transcriptomic dataset useful for ecotoxicological studies on other fish species.

TH008 Biochemical responses and histological effects resulting from foodborne exposure to post-consumer microplastics in juvenile Solea senegalensis
M. Martins, Faculty of Sciences and Technology, Universidade Nova de Lisboa / Department of Environmental Sciences and Engineering; P. Sobral, MARE - Faculty of Sciences and Technology, Universidade Nova de Lisboa / Department of Environmental Sciences and Engineering; P. Sobral, MARE - Faculty of Sciences and Technology, Universidade Nova de Lisboa / DCEA; M. Costa, MARE - Faculty of Sciences and Technology Universidade NOVA de Lisboa / Department of Environmental Sciences and Engineering
Microplastics (MPs) have dramatically increased in marine environments, being recognized as ubiquitous environmental pollutants. Two types of microplastics are usually detected in environmental samples: the primary MPs originally and intentionally manufactured MPs and the secondary MPs which result from the fragmentation of dumped plastic items. The latter are normally referred as post-consumer microplastics and usually present different shapes, colors, composition ad irregular surface. However, few toxicological studies have addressed exposure of marine organisms to post-consumer microplastics. The goal of the present research is to assess the effects of post-consumer microplastics in juvenile rainbow trout (Solea senegalensis), using diet as the microplastic vehicle. For this purpose, four distinct diets were prepared using commercial fish pellets incorporated with two MPs sizes (<200 µm and 300-500 µm) and two concentrations of each (562 and 56 MP MPs per day) and other without MPs (control), making a total of five treatments. Twenty-day laboratory assays were conducted, in duplicate, and the test pellets were processed to fish once a day. After 14, 30 and 60 days, fish were necropsied and from each treatment and sex, the liver, and stomach and 1 g of fish were excised and stored at -80°C for biochemical analysis. The digestive tract was also sampled and immersed in Davidson’s fixative for histopathological analysis. Biomarkers related with oxidative stress were analysed, namely the lipid peroxides, glutathione and the activity of catalase, superoxide dismutase and acetylcholinesterase. Histopathological analyses were also performed in the digestive tract to assess the presence of MPs and possible histopathological effects.
of Pacific whiteleg shrimp

Y. Chae, Konkuk University; D. Kim, Konkuk University / Department of Environmental Health Science; Y. An, Konkuk University / Department of Environmental Health Science

Because of enormous amounts of plastic wastes in marine environments, the concerns about marine pollution and ecological damages on marine organisms have increased. Externally, among these plastic wastes, fish and shrimp ingested small-sized plastic particles like microplastics (<5 mm in diameter) and nanoplastics (<100 nm) are getting a lot of attention and the researches about their impacts and effects in environments are under way. In this study, we assess various physical, biochemical and nutritional changes in the bodies of pacific whiteleg shrimps (Liopeneus vannamei) exposed to nanoparticles. For 21 days, shrimps were fed mussels (Mytilus edulis) contaminated with nanoparticles (44 nm diameter) and their physical (length, weight, water contents, body mass index), biochemical (catalase, CAT; glutathione S-transferase, GST; superoxide dismutase, SOD; fecal microbiota viability), and nutritional (crude lipid, crude protein, amino acids, and fatty acids) changes were assessed after exposure. In results, nanoparticles attached on the filter and ingested to shrimps entered the bodies of shrimps and affected the health and physicochemical properties of shrimps. Especially, biochemical changes were significantly induced in the bodies of shrimps. These results can be the evidence of the impacts of small sized plastics on marine organisms. This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT, and Future planning (2016R1A2B501445)

TH100

Brood Pouch-mediated Polystyrene Nanoparticle Accumulation During Daphnia magna Embryogenesis

M.G. Vijver, CML Leiden University / Conservation Biology; N.R. Brun, CML Leiden University / Institute for Environmental Sciences

Nanoplastic debris is ubiquitously distributed in aquatic environments and are considered as an emerging environmental issue of concern to aquatic organisms across trophic levels. While ingestion of particles receives most attention, other routes of uptake and cellular uptake remain unexplored. Here, the planktonic filter feeder Daphnia magna was used to track routes of uptake and target tissue of polystyrene nanoparticles (PSNP). A sub-lethal concentration of 5 mg L⁻¹ fluorescent PSNPs (25 nm) was used to monitor accumulation in adult animals as well as their embryos in the open brood pouch. A time series throughout embryonic development within the brood pouch revealed accumulation of PSNP in lipophilic cells in the early stages of embryonic development while the embryo is still surrounded by a chorion and before beginning of organogenesis. In contrast, PSNP particles were neither detected in the gut epithelium nor in lipid droplets in adults. An ex vivo exposure of embryonic brood pouch was modelled with similar size range. Therefore, this research aimed at understanding brood pouch-mediated PSNP uptake by embryos. Whether the observed brood pouch-mediated PSNP uptake ultimately translates to long-term effects under chronic exposure to environmentally relevant concentrations remains a challenging area for further research. By demonstrating embryo PSNP uptake via the brood pouch, data presented here give novel insights in bioaccumulation of nanoparticles and likely other lipophilic contaminants. Since this uptake route can occur within a diverse array of aquatic organisms, this study warrants consideration of brood pouch-mediated accumulation in efforts studying the hazards and risks of nanoparticle contamination.

TH101

Micro- and nanoplastic ingestion in blue mussel larvae

S. Rist, DTU (Technical University of Denmark) / Department of Environmental Engineering; A. Baun, Technical University of Denmark / DTU Environment; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment

A large number of aquatic species have been found to ingest microplastics in the field and in laboratory studies. Benthic invertebrates seem to be especially exposed to this form of pollution and the blue mussel Mytilus edulis is one of the species that has been investigated most in this respect. Studies have not only shown that the mussels ingest microplastics but have also reported diverse adverse effects on a cellular to a physiological level. However, the work has so far only focused on adult mussels and it is unclear how blue mussel larvae interact with and are affected by plastic particles. In this study, we investigated the uptake of PSNPs (5 µm and 250 nm) in size and nanometer range. Therefore, this research aimed at studying microplastic ingestion and potential physiological effects in blue mussel larvae. The first experiment aimed at quantifying the amount of ingested and egested particles. Ten day old larvae were exposed to two different sizes of fluorescent polystyrene microbeads (2 µm and 100 nm) and body burdens of particles were quantified after 4h. Subsequently, larvae were transferred to clean water to estimate the amount of egested particles after 4h and 72h. The second experiment investigated potential effects of plastic particles on growth and development of the larvae. They were exposed to 3 different concentrations of the 2 µm and 100 nm beads, representing low (0.45 µg/L), medium (28.7 µg/L) and high (287 µg/L) exposure levels, for 2 weeks. Every 2-3 days larvae from the different treatments were sampled, fixed and photographed to analyse larval size and morphology. Results showed that the larvae readily ingested both particle sizes although ingestion appeared to be more efficient for the 2 µm beads. Egestion of micro- and nanoplastic particles did take place but was not complete within 72h, with 43% of the 2 µm and 61% of the 100 nm particles remaining in the animals. Potential effects on larval growth and development remain to be analysed. By taking other life stages into account and using a quantitative approach for analysing particle ingestion and egestion, this study contributes to enhancing the mechanistic understanding of microplastic – blue mussel interaction.

TH102

The sub-lethal impact of polystyrene microplastics and nanoplastics on the Mediterranean mussel M. galloprovincialis

M. Capolupo, erasmus mdus PhD in Marine and coastal management (MACOMA) - University of Cadiz / Inter-Departmental Research Centre for Environmental Science (CIRSa); P. Valbonesi, University of Bologna / Department of Biological, Geological and Environmental Science (BiGea); S. Fraschetti, University of Bologna / Department of Biological, Geological and Environmental Science (BiGea); E. Fabbi, University of Bologna / Bigea Department via Selmi Bologna

The contamination of marine environments by microscopic plastic debris is a current threat to the fitness of the exposed biota, and even higher concerns are risen on its potential fragmentation to the nanoscale. In the framework of the JPI Oceans project ‘PLASTOX’, we investigated the chronic effects induced by a 21-day exposure to 1.5, 15 and 150 ng/L of polystyrene microplastics (MP, 3µm) and nanoparticles (NP, 50 nm) on the fitness of the mussel Mytilus galloprovincialis. To do so, we employed a multibiomarker approach encompassing immunological responses (lysozyme and phagocytosis), lysosomal endpoints (lysosomal membrane stability and neutral lipids), oxidative stress (catalase activity, malondialdehyde and lipofuscin content) and detoxification (glutathione S-transferase) parameters and neurotoxic effects (acetylcholinesterase activity). The lysosomal membrane stability, whose impairment is a known general stress symptom, was generally reduced in mussel hemocytes after exposure to both MP and NP; however, only in MP-treated mussels this effect was accompanied by a decreased phagocytic activity. Lysozyme activity in hemolymph was affected by either MP or NP treatments, being the lowest in the general exposure to nanoplastics. For the immune system efficiency. All the performed treatments led to an accumulation of neutral lipids in the mussel digestive gland. Moreover, an accumulation of malondialdehyde and lipofuscin was observed at 150 ng/L NP and at 1.5 and 150 ng/L MP. In gill, catalase was up-regulated following either MP (1.5 and 15 ng/L) or NP (1.5 ng/L) treatments, while a decreased acetylcholinesterase activity was noted only at 15 ng/L NP. Biomarker data were integrated in the Mussel Expert System (MES), which estimates the stress level induced on mussels by calculating a A-E scale health status index (HSI). The MES did not identify health alterations in control and at 1.5 ng/L MP (HSI = A), while the onset of a low stress level (HSI = B) was detected at 15 and 150 ng/L MP. Differently, the stress level associated to nanoplastics was only significant at 1.5 and 15 ng/L NP (HSI = B). Overall, results show that both polystyrene MP and NP induce a chronic stress syndrome in mussels by affecting lysosomal integrity and generating pro-oxidant conditions. However, the two particle types can differentially alter immunological and neurological processes, with the exposure to NP resulting in a higher impact on the overall mussel fitness compared to MP.

TH103

Effect of cationic amino (PS-NH2) polystyrene nanoparticles in brine shrimp Artemia franciscana nauplii: biochemical and molecular responses

I. Varo, CSIC Spanish National Research Council / Biology, culture and pathology of marine species; A. Petini, CSIC Spanish National Research Council; E. Monni, Universita di Siena / Physical, Earth and Environmental Sciences; I. Varo, CSIC Spanish National Research Council / Bologna Departmental Research Centre for Environment (MACOMA); E. Fabbri, University of Bologna / Department of Biological, Geological and Environmental Science

The accumulation of plastic litter on beaches and open oceans has been identified as one of the major threats in marine ecosystems worldwide. Laboratory experiments have proved that the formation of nano-sized particles during the polymer degradation may reach marine ecosystem, considered as the most in danger. In present study, the effect of 50 nm cationic amino polystyrene (PS-NH2) was investigated in nauplii of Artemia franciscana, which is commonly used as aquatic model organism in toxicity tests. Acute toxicity tests were performed on nauplii exposed to sub-lethal suspensions of PS-NH2 (0.1, 1 and 10 µg/mL) in natural sea water (NSW) for 48 hours. The toxicity was evaluated by measuring growth and several biomarkers as carboxylesterase (CHe), glutathione-S-transferase (GST), cholinesterase (Che), heat shock protein (HSP70), lipid peroxidation (LP) and catalase (CAT), involved in important physiological processes, such as biotransformation of xenobiotics, neuronal transmission and oxidative stress. The effects were evaluated by PS-NH2 (at 0.1 and 1 µg/mL) on the expression of genes related to metabolism, biosynthesis and embryogenesis during the development of brine shrimp was also investigated. Genes included HSP26, HSP70, mitochondrial uncoupling protein 2 (UCP2), chaperon-containing TCP (TCP) and late embryogenesis abundant (LEA). Acute exposure to sub-lethal suspensions PS-NH2 caused a significant decrease in growth in A. franciscana nauplii, as well as significant changes in all biomarkers studied, except for LP. A significant up-regulation of HSP26 and HSP70 was observed in nauplii exposed to 1 µg/mL of PS-NH2 as well as the modulation of TCP, the latter not significant. This supports the results obtained from biomarkers, suggesting a stress response and potential
apoptotic pathway following PS-NH₂ exposure. On the contrary, no significant effect on gene expression related to the brine shrimp’s metabolism (UCP2) was observed, and LEA was significantly modulated only at the lowest concentration tested. These findings indicate that stress-related responses are taking place in exposed nauplii after acute exposure to sub-lethal suspensions of PS-NH₂, and confirm the general concern about PS-NH₂ and their ability to represent an ecological treat for marine organisms. Given the increasing levels of plastic pollution in the oceans, additional studies should be done considering long-term exposure to analyze the potential risk of nano-sized plastics in marine environments.

TH014 The impact of nanoparticles on Antarctic krill Euphausia superba
E. Bergami, G. Liberatori, University of Siena / Department of Physical, Earth and Environmental Sciences; C. Manno, C.M. Waluda, British Antarctic Survey; S. Cappello, CNR IAMC; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences

Under current climate change scenarios, Antarctic krill (Euphausia superba) is facing multiple stressors, which could affect its abundance and distribution. Microplastics have been recently reported in Antarctic waters, representing an additional potential impact on krill population. In this study we investigated the effects of model nanoparticles (< 1 μm) on krill juveniles through short-term exposure (48 h) of polystyrene nanoparticles (PS NPs) with different surface charge. The behaviour of anionic (60 nm PS-COOH) and cationic (50 nm PS-NH₂) NPs in Antarctic natural seawater (NSW, 34‰, 2°C) was also investigated by Dynamic Light Scattering. PS-COOH formed nanoscale aggregates (average size of 862 nm) in Antarctic NSW, while PS-NH₂ maintained their nominal size. No mortality was observed upon exposure to 2.5 μg/ml PS NPs after 48 h. However, krill exposed to PS-NH₂ showed lower motility than individuals exposed to PS-COOH and were characterised by significant up-regulation of α6 β6 gene involved in new formation of chitin for PS-NH₂ treatment. Similarly, microcrustaceans have been associated with mortality over long-term exposure. Both PS NPs also accumulated in faecal pellets (FPs), which were characterised by lower density and sinking rate compared to control. Our findings demonstrate that PS NPs are able to affect swimming behaviour, cuticle formation and FPs properties of Antarctic krill, with potential serious consequences on Southern Ocean food web and biogeochemical cycle.

TH015 Exposure to nanoparticles as a potential stressor on Mytilus galloprovincialis L. Brandt, M. Teles, Universidad Autonoma de Barcelona; A.P. Gonçalves, B. Barreto, University of Aveiro / Biology Department & CESAM; J. Ferreira, Franco-Martinez, A. Tvarijonaviciute, Universidad de Murcia; M.A. Martins, University of Aveiro / Chemistry Department & CICECO; A.M. Soares, University of Aveiro / department of Biology & CESAM; L. Tort, Universitat Autonoma Barcelona / Department of Cell Biology Physiology and Immunology; M. Oliveira, University of Aveiro

Physical and chemical marine environment is a worldwide problem, especially since plastic materials degrade into nano-size particles, becoming more bioavailable and constituting a source of entry of other contaminants into marine organisms. The present study aimed to assess the effects of polystyrene nanoparticles (PSNP) and clarify their modulation of short-term carbamazepine (cbl) toxicity on bivalve Mytilus galloprovincialis. Mussels were exposed for 96h to increasing concentrations of PSNP. Molecular and biochemical biomarkers were evaluated in digestive gland and gills and hemolymph. Abundance of mRNA in digestive gland and gills revealed significant alterations in expression of genes associated with biotransformation, DNA repair, cell stress-response and innate immunity. Combined exposure induced significant down regulation in gene expression when compared to individual exposure. Total oxidant status values suggest oxidative stress after exposure to 0.5 mg/L PSNP, whereas increased total antioxidant capacity and esterase activity suggest activation of antioxidant defenses after exposure to 50 mg/L. PSNP Exposure to 0.05 and 0.5 mg/L PSNP induced effects on neurotransmission in hemolymph. In gills, almost all experimental exposures induced inhibition of AST and ALT values. Genotoxicity was found in hemocytes after exposure to PSNP, cbl and their mixture.

TH016 The role of microplastic size and type on PAH sorption and bioavailability to copepods
L. Størensen, SINTEF Ocean / Environmental Technology; E. Rogers, Norwegian University of Science and Technology; M.U. Ronsberg, SINTEF Ocean / Environmental Technology; D. Altin, BioTrix; A. Booth, SINTEF Ocean / Environmental Technology

It has been proposed that microplastic (MP) may act as a vector for a wide range of chemical pollutants already present in the environment. Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous pollutants in the environment, known to cause adverse effects to a variety of marine organisms. Most PAHs have relatively high polymer-water partition coefficients, meaning their potential for sorption to, and transport by, MP is high. In both field and laboratory studies, a broad range of marine species have been shown to ingest significant quantities of MP, with extended periods of retention observed in some cases. If PAHs are adsorbed to the MPs, this could present an alternative exposure route to PAHs for such species. However, the effect of MP sorption on PAH bioavailability in the marine environment remains poorly understood. Although several studies have attempted to study bioavailability of MP-adsorbed PAHs to aquatic organisms, most studies employ approaches that are unable to accurately determine if PAHs are being released from adsorbed compounds or free compounds that have dissolved from the MPs into the exposure media. Here, we investigate the sorption kinetics and present adsorption isotherms for three model PAHs (fluoranthene, phenanthrene and 1,3-dimethylphenanthrene) to a range of different MP’s in marine seawater. The selected MPs exhibit different sizes and hydrophobicities, thus having varying surface solubility (two orders of magnitude). In the case of the least soluble fluorescent compound, fluoranthene, MP sorption could prove an important route of uptake in pelagic organisms. To account for the natural variability of MPs present in the marine environment, test materials with different sizes, shape (particles, fibres) and polymer compositions (polystyrene and polystyrene microbeads, polyster microfibres) were used. Using a novel approach, the influence of MP sorption on PAH bioavailability to two marine copepod species (Acartia tonsa and Calanus finmarchicus) was investigated using polystyrene particles with size ranges above and below the ingestion limit for the two species. The range of MP diameters used in the experiments was ~ 10-300 μm. Chemical body burden was measured after exposure to determine bioavailability. n

TH017 Limited influence of microplastics on the effects of an endocrine disruptor on the African clawed frog (Xenopus laevis)
S. Rehse, Leibniz-Institute of Freshwater Ecology and Inland Fisheries / Ecophysiology and Aquaculture; A.zikova, W. Kleiner, W. Kloos, Leibniz-Institute of Freshwater Ecology and Inland Fisheries; C. Zarfil, University of Tuebingen / Center for Applied Geoscience and Aquaculture; A. Tvarijonaviciute, Universidad de Murcia; M.A. Martins, University of Aveiro / Chemistry Department & CICECO; A.M. Soares, University of Aveiro / department of Biology & CESAM; L. Tort, Universitat Autonoma Barcelona / Department of Cell Biology Physiology and Immunology; M. Oliveira, University of Aveiro

Microplastics have been recently reported in Antarctic waters, representing an ecological treat for marine organisms. Given the increasing levels of plastic pollution in the oceans, additional studies should be done considering long-term exposure to analyze the potential risk of nano-sized plastics in marine environments.
Arctic), a range of different virgin polymer pellets (LDPE, PP, PS and PET), as well as marine litter-derived microplastic particles from the fish box, were deployed underwater in the small boat harbor at Tromsø, Northern Norway for up to 12 months. The deployment device consisted of an empty stainless steel SMPL canister, with the various plastic types placed in reusable, empty teabags made of PP, placed separately in nylon netting. Sampling was conducted 1 week, 1 month, 3 months, 6 months and 12 months after deployment. Hydobiid persistent organic pollutants such as PAHs, PCBs, DDTs, PBDEs and pesticides were measured to establish the adsorption kinetics in seawater under Arctic conditions. Samples were extracted using ultrasound and nonpolar solvents, followed by GPC and SPE clean up. Chemicals analyses using GC/MS/MS and GCxGCxMS was done in the laboratories of the TU Darmstadt and NILU, Tromsø. In addition, release kinetics of common phytoplankton phthalates, organophosphorous esters, bisphenol A and perfluorinated chemicals were estimated from other four post-industrial virgin pellets (LDPE, PS, PVC, PET) according to the same sampling protocol. Chemical analysis was performed using either GC/MS or LC-QTOF.

TH019 Characterization of microplastics present in personal care products and the study of its toxicity mixed with chlorpyrifos on juveniles of Solea senegalensis.

G. Albenídez, Universidad de Cádiz (Spain) / Toxicology Area; I. Cabrera-Pozo, University of Cadiz / Toxicology Area; D. Coello, R. Rodríguez-Barroso, J. Quiroga, University of Cadiz / Environmental Technology; J. Arellano, University of Cadiz / Toxicology Area.

In the last decade, different components from personal care products have arrived at aquatic ecosystems because these products are not biodegraded or removed in wastewater treatment plants. Some of the personal care products contain plastic microbead such as exfoliating shower gel, toothpaste and make-up. Creams commonly used and available in supermarkets of our area were used by these assays. The microspheres available in these samples were separated and chlorinated. The particles were identified by Fourier transform-infrared (FT-IR) spectroscopy using a PerkinElmer Spectrum 100. The spectra are recorded in reflection mode in the spectral range 4000-650 cm$^{-1}$ by co-adding 128 scans at a resolution of 4 cm$^{-1}$, the particles were identified by comparing FT-IR absorbance spectra of the microplastics to those in a polymer reference library. The microplastics were used in toxicity test. In aquatic ecosystems and their organisms are exposed to complex mixtures of environmental contaminants as pesticides and microplastics. Thus, the effects of microplastics interaction with chlorpyrifos, an organophosphate pesticide, have been studied in this work. The toxicity studies were carried out during 96 hours with continuous ventilation and water renewal every 24 hours, at a temperature of 19-20°C and under 12h light/12h dark exposure. The juveniles of Solea senegalensis (weight 3.07±0.49 g) were exposed to five nominal concentrations of chlorpyrifos (5–80 µg/l), three concentrations on this compound mixed with microplastics (chlorpyrifos: 5-10-20 µg/l; microplastics: 0.150 mg/l), microplastics alone (0.150 mg/l), plus an untreated control and a solvent control (acetone). In these assays not mortality was observed on juveniles with both compounds and their mixtures. Cholinesterases (CHE) have been used as specific biomarkers to study feeding and different factors that affect their activities. In general, there are two type of CHE presented in fish, acetylcholinesterase (ACHE) and butyrylcholinesterase (BChE). The ACHE was analyzed on the head homogenate of juveniles, after this crude was inhibited with iso-OMPA, which is a specific inhibitor of BChE. The results showed that there was inhibition activity in the head of Solea senegalensis in presence of chlorpyrifos. However, it was not observed significant differences between the same concentrations of chlorpyrifos and its mixture with microplastics.

TH020 Are microplastics inhibitory to Daphnia magna and are they significant vectors for hydrophobic organic pollutants?

C.K. Frydkjær, Aalborg University / Biology and Environmental Science; N. Iversen, Aalborg University / Department of Chemistry and Bioscience; P. Roslev, Aalborg University / Biology and Environmental Science

The presence of microplastics in aquatic ecosystems is of increasing global concern. Ingestion of microplastics may result in adverse effects in aquatic organisms, and studies aiming at increasing our understanding of the effects resulting from dietary exposures to microplastics particles focus on the transfer of chemicals. The chemical control was for some treatments lower than the particle groups indicating a particle-mediated chemical transfer in fish.

TH021 Microplastics as vector for hydrophobic organic chemicals in fish: a comparison of two polymers and silica particles, using three different model compounds

M. Trefvall, University of Gothenburg Sweden; G. Asmaonea, University of Gothenburg / Department of Biological and Environmental Sciences; E. Westberg, I. IVL Swedish Environmental Research Institute; D. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences

Plastic pollution is a recognized global issue and the ubiquity of microplastics (MPs) in aquatic environment is a cause for concern. Potential effects on organisms are still not fully understood, and mechanistic understanding, required to fully reveal consequences of exposure, especially in connection to chemical mixtures, is still lacking. Studies have shown that MPs have capacity to sorb and concentrate hydrophobic organic chemicals (HOCs) in the aquatic environment. There is an ongoing debate about MPs as vectors for chemical contaminants and their relative importance compared to other naturally occurring particulates. The goal of present study was to quantify particle-mediated chemical transfer and using biomarker approach examine associated biological effects in three spined stickleback (Gasterosteus aculeatus). A total of 120 individuals, separated into 3 groups, each with a range of different virgin polymer particles (silica), were exposed to a chemical mixture (PEPS mixture, PE-PS, silica), diets containing, particles spiked with a chemical mixture (PE-mix, PS-mix, silica-mix) and, finally, diets loaded with only chemical mixture (chemical control) were developed. During the experiment, fish were fed daily (6 % of body weight and 5 % particles) for a period of two weeks. Gene expression of acetylcholinesterase (ACHE) was determined by qPCR. Control was analyzed on the hepatic tissue of fish exposed to PS MPs via gene expression study. Hepatic biomarker responses were found in significant range compared to natural plankton organisms (bacteria, yeast and algae). The abundance of phytoplankton and bacterioplankton is often much greater in aquatic ecosystems than the present concentration of microplastic particles. However, live and dead planktonic organisms are likely more sensitive to the sorption of hydrophobic pollutants than microplastics. This suggests a more limited role of microplastics as significant aquatic vectors for hydrophobic pollutants under current environmental conditions.

TH022 Dietary exposure to poly styrene microplastics contaminated with environmental pollutants induce hepatic biomarker responses in fish

G. Asmaonea, University of Gothenburg / Department of Biological and Environmental Sciences; B. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences

In the field of microplastics (MPs) research, poly styrene (PS) particles have become relevant material not only for investigating the uptake of the particles, but also for assessing biological effects. There is growing body of (eco)toxicological information, suggesting that PS MPs, in a range of nano- to micro- meters (< 50µm), have a potential to impact aquatic organisms. On the other hand, there is an evident lack of toxicological information in regards to bigger size ranges of these particles (>50µm), at sizes, detectable in the environmental matrices. We conducted an experimental study aimed at elucidating effects resulting from dietary exposures to PS particles ranging in size 50-250 µm. In this study, the three-spined stickleback (Onocorynchus mykiss) were exposed diets, enriched with PS particles (10mg of PS MPs/fish/day) for 28 days. We used environmentally contaminated PS particles from in situ exposures from two environmental matrices (undiluted sewage effluent and industrial harbor runoff). As PS MPs largely exceeded sizes relevant for biological uptake, it provide an unique opportunity to study particles’ role as vector for environmental pollutants. Three different experimental diets, containing PS, (PS, sewage (PS-sewage) and harbor (PS-harb) exposed particles), were developed. Thereafter, a suite of oxidative stress biomarkers was investigated in the hepatic tissue of fish exposed to PS MPs via gene expression analysis (NRF2, GR, GST, GS, GPx, CAT, GCLmod, GCLcat, SOD) and enzymatic assays (GR, GST, GS, GPx, CAT). Additionally, mRNA levels of established biomarkers (CYP1a, ERα and β, AR, MT, VTG) were quantified to provide additional insights into xenobiotic-related hepatic responses to dietary PS MPs exposures. The findings of this study revealed an indication of NRF2-mediated oxidative stress regulation.
Fish from PS-sewage and PS-harbor treatments had altered expression levels of multiple antioxidant enzymes in liver. Dietary exposure to PS MPs resulted in low-level activation of hepatic oxidative stress, which may not necessarily exert harmful effects on hepatic physiology, but may rather indicate adaptive homeostatic regulation. Differential responses to different PS MPs treatments (PS-sewage and PS-harbor) potentially could be explained by different chemicals associated with particles during in situ exposures.

**TH023**

**Effects of Nanopolystyrene and the Co-Contaminant Tributyltin on the Nematode Community Structure in Sandy Sediments**

A. Catarrino, A. Homer, Heriot Watt University / ILES; L. Duran Saja, Heriot Watt University; M. Soto, Basque Government (consolidated group IT810-13) and EPS; M. Al SID Cheikh, University of the Basque Country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; E. Navarro, University of the Basque country UPV/EHU; M. Cajaraville, University of the Basque country UPV/EHU; A. dos Santos, Faculdade de Ciências Farmacêuticas and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; C. Zabala, University of the Basque country UPV/EHU; J. Lacave, University of the Basque country UPV/EHU; A. Orbea, University of the Basque country UPV/EHU / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; E. Navarro, University of the Basque country UPV/EHU; M. Cajaraville, University of the Basque country / CBET Research Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE.

Due to their hydrophobicity and relatively large surface area, microplastics (MPs) can act as carriers of hydrophobic pollutants in the ocean and may facilitate their transfer to organisms (so-called “Trojan-horse effect”). This study examined the effects of different levels of biological oxygen demand (BOD) on MP exposure was used to determine the effects of MP size and the presence of adsorbed contaminants on the organism. MPs were provided daily, mixed with algae, at 1000 particles/ml/day, during 7 and 26 days. Effects were determined on early cellular biomarkers (catalase activity [CAT], neutral red uptake [NR] and DNA damage in hemocytes; histopathology in digestive gland) and on biotransformation responses (scope for growth [SFG] and condition index). Chemical analysis showed that BaP concentrations in mussel increased with time (up to 150 times greater than background levels) and that smaller MPs posed an increased hazard in terms of the transfer of adsorbed BaP. In histology, large MPs were abundant in the lumen of stomach, mixed with stomach contents, and in the lumen of digestive tubes (DTs), associated to cell debris. Occasionally they appeared within epithelial cells of the stomach, ducts and DTs and in the connective tissue. Small MPs were also abundant in the lumen of stomach. In all samples, DT appearance indicated a high digestive activity, confirmed by hexosaminidase histochemistry. Overall, effects in all treatments increased with exposure time. Increased effects of MPs+BaP compared to MPs alone were seen in NR and in the DNA damage in hemocytes; histopathology in digestive gland. DNA damage despite the genotoxicity of BaP. An apparent increased effect of smaller MPs on DNA damage was also found. A general horrific effect was demonstrated on SFG across MP treatments. This may be due to a compensatory effect whereby mussels increased their absorption efficiency in order to increase energy intake to make up for energy used dealing with stress observed in biomarker responses. This evidenced a link between MP concentration and DNA damage. This suggests that effects of MP exposure is not a linear relationship depending on their size. MPs and NPs can also be sp...
supernatant by SPME/GC/MS. To measure BaP adsorbed to the plastics (A-BaP), plastic solutions were freeze-dried and subjected to microwave-assisted extraction before GC/MS analysis. The ad/sorption capacity of the plastics was calculated in mass of adsorbed BaP per gram of plastic (µg g⁻¹) for the different sizes of plastics in order to determine the capacity of adsorption of polystyrene microbeads and whether this process was directly dependent on plastic size. Results indicated that the plastic particle size affected the amount of adsorbed BaP. The highest ad/sorption capacity was found for 4.5 µm MPs. The percentages of adsorbed BaP/p from the total BaP/p solution were 90.88% and 37.18% with a Qmax of 217.39 µg g⁻¹ and 18.83 µg g⁻¹ (Langmuir model); R²: 0.9862 and 0.9477 for 0.5 µm and 4.5 µm MPs, respectively. In both cases the applied methodology was successful to characterise the ad/sorption process of BaP/p to MPs and is currently being applied to NPs. * Funded by French ANR (NANOEX-03-02 and Cluster Excellence COFRA (ANR-10-LABX 45)), Spanish MINECO (NACE project — CTM2016-8130-R); Basque Government (consolidated research group IT510-13) and UPV/EHU (UFI 11/37 and grant to IMA).

TH027 Occurrence of microplastics in epibenthic and sediment–dwelling species in a Norwegian fjord a. hovg. ECOLAB UMR254 CNRS UPS IRT; C. G. Avio, L. Pittura, S. Gorbi, Department of Life and Environmental Sciences, Polytechnic University of Marche, Ancona, Italy; F. Regoli, Università Politecnica delle Marche; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Marine Affairs. The exponential production and use of plastics has generated millions of tons of plastic waste over the past decades, and the presence of microplastics has been reported throughout the world’s oceans. The ingestion of microplastics in situ has been shown in various species, but important knowledge gaps remain, as most studies focus on pelagic fish species or bivalves used for human consumption. Here, we report the presence of microplastics in ten sediment–dwelling and epibenthic species representative of different feeding modes and trophic levels. The species analyzed include fish, bivalves, echinoderms, crustaceans and polychaetes. Organisms were sampled in the inner Oslofjord (Oslo, Norway), which is a fjord subject to strong anthropogenic pressures. High occurrence of plastic contamination was observed, with microplastic particles found in all species and in half of the individuals on average, and present in 75% of the individuals for some species. The extracted microplastics had various shapes (fibers, fragments, flakes), colors and sizes. Micro–FT-IR analysis revealed the presence of various plastic polymers: polystyrene, polypropylene and polyamide were the most commonly found, with 37%, 25% and 15% respectively. We hypothesize that maritime and fishing lines are usually made of these polymers. Six other types of microplastics were also found, less frequently: PET, PBT, EVA, polystyrene, polycrylic, and copolymers. These results underline the potential risk posed by microplastics in sediments and the importance of assessing microplastic occurrence and impacts in benthic environments.

TH028 Development of an optimal analytical protocol for the extraction of persistent organic pollutants adsorbed on plastic debris in the environment K. Sakaguchi-Soeder, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; T. Neveuglès, Technische Universitaet Darmstadt / Department of Civil and Environmental Engineering; A. Goharnia, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy; M. Gottschling, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; A. van Oyen, Private Partner GmbH. Accumulation of persistent organic pollutants (POPs)-loaded microplastics (MPs) in the aquatic milieu is an emerging issue of international concern. Qualitative/quantitative determination of POPs in MPs is essential for the estimation of the impact of POPs-loaded MPs on a range of marine organisms. In general, hydrophobic pollutants like POPs are first extracted from the matrix, in this case plastic debris, using non-source of release for these compounds. Indeed, ropes and fishing lines are usually made of these polymers. Six other types of microplastics were also found, less frequently: PET, PBT, EVA, polystyrene, polycrylic, and copolymers. These results underline the potential risk posed by microplastics in sediments and the importance of assessing microplastic occurrence and impacts in benthic environments.

TH029 Comparison of spiking and dialysis tubing methods for the determination of sorption capacity and plastic-water partition coefficient of three different polyolefin hydrocarbons on microplastics M. Gottschling, G. Zhou, I. Schwabe, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; A. van Oyen, Plastic Partner GmbH; L. Schebek, Technische Universitaet Darmstadt / Institute IWAR Material Flow Management and Resource Economy Germany; K. Sakaguchi-Soeder, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; M. Gottschling, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; A. van Oyen, Private Partner GmbH. Determination of sorption capacity of persistent organic pollutants (POPs) on microplastics (MPs) is essential to study ecological effect of POPs-loaded MPs in the aqueous environment. However, due to high octanol-water partition coefficients (Kow) as well as low water solubility, determination of sorption capacity of POPs on MPs in the laboratory is challenging. Here we present two methods to determine plastic-water partition coefficient of three polyolefin aromatic hydrocarbons (PAHs) on low-density polyethylene (LDPE): conventional spiking method and cellulose dialysis tubing method in batch test in the laboratory. PAHs selected for this test were naphthalene (log Kow = 3.3 ), phenanthrene (log Kow = 4.4 ) and fluoranthene (log Kow = 5.16 ). The plastic samples tested here are LDPE pellets with no amount of additives. LDPE pellets were previously characterised by CARAT GmbH (Bochum). For the spiking method, batch reactors containing given amount of LDPE and MiliQ water were prepared. A high concentration of single PAHs in ethanol solution was injected into each batch reactor until the PAH concentration became stable. PAH concentration in the batch was controlled using high performance liquid chromatography (HPLC). For the dialysis tubing method, on the other hand, a closed dialysis tubing (permeability of 12,000-14,000 Dalton) containing a given amount of LDPE and MilliQ water was placed in each batch reactor filled with MilliQ water with single PAHs far above solubility. The water concentration outside of the tubing was expected to stay constant (= water solubility) during the entire experiment. The PAH concentration in the dialysis tubing was controlled using HPLC until the PAH concentration became stable. All batch reactors were placed on a horizontal shaker. When the adsorption of PAHs is completed, PAHs on LDPE are to be extracted and quantified using gas chromatography-mass spectrometry (GC/MS). Sorption capacity of each PAH was derived from the experiments and methods were compared. PE-water partition coefficient of these PAHs were derived based on the sorption capacity using adsorption models. TU Darmstadt and CARAT are participants of an EU project „PLASTOX“, a consortium of a JPI Ocean’s Joint Action.

TH030 Microplastics in food and beverages - a distorted perspective on risk S. Rist, DTU (Technical University of Denmark) / Department of Environmental Engineering; B.C. Alnroth, University of Gothenburg / Department of Biological and Environmental Sciences; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; T.M. Karlsson, University of Gothenburg. Microplastics are ubiquitous in aquatic environments and they are ingested by a wide range of animals, including species for human consumption, i.e. bivalves and fish. Additionally, plastic particles have been reported in other food products and beverages, like honey, salt, beer and drinking water. This has triggered a discussion on the human health implications of this contamination – an aspect that has gained increasing attention in the scientific and public debate in recent years. The focus and extent of this debate, however, stands in contrast with scientific findings, which merely show the presence of microplastics in certain products but no actual effects on humans. It is without question that plastics can constitute a human health risk, but the extent of this potential to participate in toxicology, however, the degree to which microplastic exposure via food products and beverages contributes to this health risk is likely insignificant at present time. When considering the magnitude of plastic usage and consequential exposure to plastic materials in our everyday lives, the relatively few microplastic particles that have been reported in food products and beverages will likely only constitute a minor exposure pathway for microplastics and associated chemicals. But as this is rarely put into perspective, the current debate creates a distorted picture of plastic exposure and risks to humans, resulting in a misdirected outrage when people find out about plastic particles in fish, while they at the same time not reflect on the plastic container in which the fish is packaged for transport to stores and homes. In this way, the focus is taken away from the root of the problem, namely our use, disposal and consumption of plastic materials. We therefore want to encourage a more balanced and careful discussion on human health implications of plastics that takes these aspects into account.
Is the Arctic threatened by plastics? Identifying sources and determining the distribution of microplastics around Svalbard

L. Winberg von Friesen, University of Gothenburg, Sweden / Marine Sciences; M. Hassellöv, University of Gothenburg / Department of Marine Sciences; G.W. Gabrielsen, H. Hop, Norwegian Polar Institute; T. Brown, Scottish Association for Marine Science; M.E. Granberg, IVL-Swedish Environmental Research Institute / Research Group on Plastics

Where is all the plastic, and what concentration of microplastics are ecosystems being exposed to? These are puzzling questions to the scientific community when comparing estimated values on annual plastic pollution with the actual measurements in the world’s ocean habitats. Recent investigations find plastic far away from any populated areas, such as in deep ocean sediments and buried within polar sea ice. The Arctic Ocean has, despite its remoteness, been suggested as a sink for plastic. Fed by the thermohaline circulation driven deep-water formation, the Arctic Ocean’s bottom might be a dead end for plastics. However, very few studies have quantified the actual environmental concentrations of plastics in this remote area, thus the exposure to organisms living in this environment and potential effects are unknown. In this study, we investigated the occurrence, potential sources and distribution of microplastics in the Norwegian Arctic. We quantified and characterized anthropogenic particles >10µm in different environmental compartments (sediment, water, benthic invertebrates and sea ice) around the western and northern coasts of Svalbard. Samples were collected close to a sewage outlet and far from human activities close to the sea ice front in the Arctic Ocean. By comparing plastics and chemical additives have led to an upswing in the debate. These compounds associated with different water masses (Atlantic, Arctic and sewage water as well as sea ice) could be quantified. Simultaneous measurements of organic matter tracers for sea ice microalgae (IP25), pelagic microalgae (C25:3) and sewage (coprostanol) enabled correlations to be made on potential sources, pathways and fate of microplastics in the Arctic. Additional analyses of the presence of plastic specific contaminants in sediment and biota facilitated a discussion on potential exposure independent of particle accumulation in the gut. One of the primary objectives of the investigation was to determine the relative importance of local and remote sources for plastic contamination in the Arctic, and preliminary results indicate a clear signal from local sources and sea ice. In order to evaluate the risk posed by microplastics in the Arctic, a study already burdened by multiple stressors, knowledge about sources, fate and concentration of microplastics in different environmental compartments is crucial.

Addressing species diversity in biotransformation: variability in expressed transcripts of hepatic biotransformation enzymes among fishes.


There is increasing evidence that diverse xenobiotic metabolizing enzymes exist among fishes, potentially resulting in different chemical sensitivities and accumulation, but this has never been systematically evaluated. One concern is that model test species such as rainbow trout, zebrafish and fathead minnows may not adequately represent the xenobiotic metabolizing capacity of other fish species. Our current study aimed at comparing the expression of gene transcripts associated with the xenobiotic metabolism in two dozen full-transcript, isoform sequencing on liver samples from two dozen phylogenetically diverse fish species. This novel RNAseq approach eliminated the need for transcriptome reconstruction resulting in reference genomes of the highest precision, allowing for detection of enzyme isoform orthologs among the species, as well as the nuclear receptors that control expression of the enzymes. Species were selected for broad phylogenetic coverage, as well as economic, research, and conservation importance, and included: sea lamprey (Petromyzon marinus), lake sturgeon (Acipenser fulvescens), American eel (Anguilla rostrata), alligator gar (Atractosteus spatula), paddlefish (Polyodon spathula), rainbow trout (Oncorhynchus mykiss), rainbow smelt (Osmerus mordax), fathead minnow (Pimephales promelas), Antarctic icefish (Trematomus lawrensi), common carp (Cyprinus carpio), and channel catfish (Ictalurus punctatus). In addition to comparing information across fish species, the resolved isoforms were compared to human xenobiotic metabolizing enzymes. This comparison aids in evaluating the utility of human-based biotransformation tools such as ToxCast chemical screening assays or metabolism prediction software for potential relevance in fish. The content of this presentation neither constitute nor necessarily reflect US EPA policy.

Metabolism of Organophosphate Flame Retardants (OPFRs) in Freshwater Fish: Field and Laboratory Studies

L. Xue, R. Hou, X. Liu, N. MacKenzie, W. Chen / Center for EcoEnvironmental Sciences, Chinese Academy of Sciences / Key Laboratory of Drinking Water Science and Technology; Z. Wang, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences / State Key Laboratory of Environmental Aquatic Chemistry

Organophosphate flame retardants (PFRs), as widely used alternatives of bromine flame retardants, are found in a wide array of consumer products and environmental matrices. Considering the adverse effects of PFRs, many researchers have paid their attention on the absorption, bioaccumulation, metabolism and internal exposure processes of PFRs in wildlife and human. PFRs can be rapidly metabolized in the body. The general metabolic pathway of PFRs revealed by certain in vitro studies includes dealkylation, hydroxylation, carboxylation, oxidative dehalogenation and phase II conjugation, resulting in a wide array of metabolites. De-alkyl phosphates (DAPs) from the dealkylation metabolism were recently deemed important biomarkers in human biomonitoring studies. As very limited information is available on DAP metabolites in environmental biotic samples, we first investigate...
the accumulation and tissue distribution of eight common OPs and their four DAP metabolites in three freshwater fish species from locations around Beijing, China. Accumulation of DAPs were relatively lower but comparable to those of PFRs in freshwater fish. DAPs had low limited affinity to lipid content in tissues, similarly like their parent compounds PFRs. Liver was identified to have a higher accumulation of DAPs and DAPs than the other tissues of fish. It suggested the exposure of DAPs to fish in wild animal studies. In the consequent laboratory control study, we screened the metabolites of alkyl-PFRs by in vivo exposure of *Gobiocypris rarus*. Metabolites of alkyl-PFRs in fish liver after 30-day exposure were analyzed with UPLC-QTOF/MS in MSE mode. The qualitative results verified the metabolic pathway of dealkylation, hydroxylation, dihydroxylation, desaturation, and phase II glucuronide conjugation for all the tested three alkyl-PFRs. We identified and accurately quantified the metabolites 3-OH-TBOEP, BBOEHEP, and 3-OH-TNBP formed in fish liver microsomes. Liver rather than intestine, plays the primary role in PFR clearance in fish. The significance of these metabolites is in good agreement with human urine monitoring and in vivo rat exposure studies. Overall, the results emphasized the importance of hydroxylated metabolites as biomarkers for alkyl-PFRs exposure.

**TH036** Bioaccumulation and biotransformation of prochloraz in the aquatic invertebrate *Hyalella azteca* 

D. Fedrizzi, Eawag - Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; A. Rösch, Eawag / Environmental Chemistry; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences; J. Hollender, Eawag / Environmental Chemistry

Prochloraz is a widely applied fungicide for pest management purposes. Due to its high persistence as well as its ability to be bioaccumulated, it can pose a risk for non-target organisms. In this context, the present work evaluates the possible adverse effects of these emerging pollutants in exposed non-target organisms. The aim of this study was to assess the toxicokinetics of prochloraz and its biotransformation products (BTPs) in *Hyalella azteca*. Adults of *Hyalella azteca* were exposed to prochloraz at the concentration of 100 µg L⁻¹ during a 24-hour uptake phase and a subsequent 120-hour depuration phase. Organisms were sampled over time and after extraction, the internal concentration of prochloraz and its BTPs were quantified using reverse phase liquid chromatography coupled to high resolution mass spectrometry with electrospray ionization. Prochloraz and its 30 BTPs were detected, quantified, and respective toxicokinetic profiles were obtained. In every profile, an increase in the internal concentration was seen during the uptake phase followed by a decrease during the depuration phase. The bioaccumulation factor was calculated to be 110 L·kg⁻¹. Finally, the data will be modulated using a toxicokinetics and biotransformation model and the transformation rate constants will enable determining the role of biotransformation in the detoxification of prochloraz in *Hyalella azteca*.

**TH037** Toxicokinetics and metabolite identification of two emerging pollutants, Atrazine-K and 4-MBC, in the manila clam *Ruditapes philippinarum*. N.C. Ruiz, INMAR - University of Cadiz / Physical Chemistry; F. Tonini, Alma Mater Studiorum - University of Bologna; P. Lara-Martín, University of Cadiz / Physical Chemistry; J. Blasco, Inst. Ciencias Marinas de Andalucia / ECOLOGY AND COASTAL MANAGEMENT; M. Hampel, INMAR - University of Cadiz

Marine ecosystems have been historically sinks for many pollutants and chemicals whose effects awoke social concern, triggering the implementation of legislations. Nowadays, new compounds are developed at increasing rates and even surface runoff, prochloraz enters the aquatic environment where it can be bioaccumulated by non-target organisms. It has been recognized as a model organism to test toxicity of organic chemicals due to its rapid life cycle, the feasibility of cultivation and its sensitivity to xenobiotics. Biotransformation is a primary detoxification process through which organisms defend themselves from xenobiotics. Biotransformation can reduce the internal concentration of parent compounds hence, influencing their bioaccumulation. The aim of the study was to assess the toxicokinetics of prochloraz and its biotransformation products (BTPs) in *Hyalella azteca*. Adults of *Hyalella azteca* were exposed to prochloraz at the concentration of 100 µg L⁻¹ during a 24-hour uptake phase and a subsequent 120-hour depuration phase. Organisms were sampled over time and after extraction, the internal concentration of prochloraz and its BTPs were quantified using reverse phase liquid chromatography coupled to high resolution mass spectrometry with electrospray ionization. Prochloraz and its 30 BTPs were detected, quantified, and respective toxicokinetic profiles were obtained. In every profile, an increase in the internal concentration was seen during the uptake phase followed by a decrease during the depuration phase. The bioaccumulation factor was calculated to be 110 L·kg⁻¹. Finally, the data will be modulated using a toxicokinetics and biotransformation model and the transformation rate constants will enable determining the role of biotransformation in the detoxification of prochloraz in *Hyalella azteca*.

**TH038** Organophosphate Esters, Including Alkyl-Substituted Triphenyl Phosphates, in East Greenland Polar Bears and Ringed Seals: Adipose Tissue Concentrations and In Vitro Depletion and Metabolite Formation A. Strobel, Carleton University; W.G. Willmore, Carleton University / Biology department; C. Sonne, R. Dietz, Aarhus University / Department of Biosciences, Arctic Research Centre; R.J. Letcher, Environment and Climate Change Canada / Ecology and Insecticide and Wildland Herbicide Research

Concentrations and In Vitro Depletion and Metabolite Formation of six environmentally relevant organophosphate (OP) triesters and corresponding OP diester formation were investigated in East Greenland (Scoresby Sound region) polar bears (PBs) and ringed seals (RSs; *Pusa hispida*). The in vitro OP triester metabolism assay results were compared to fat (adipose) levels of selected OP triesters in field samples from the same individual animals. In vitro OP triester metabolism was generally rapid and structure-dependent, where PBs metabolized OPs more rapidly than RSs. Exceptions were the lack of triethylphosphate metabolism and slow metabolism of tris (2-ethylhexyl) phosphate in both species. OP diester metabolites were also formed with the exception of triphenyl phosphate (TPHP) which was not metabolized at all in the RS assay. Tri (1-dichloro-2-propoxy) phosphate was completely converted to its corresponding diester. However, the mass balances showed that OP diester formation corresponding to tris (2-ethylhexyl) phosphate, tri (n-buty) phosphate, and tris (2-butoxyethyl) phosphate did not account for 100% of the OP triester depletion, which indicated alternate pathways of OP triester metabolism. TPHP was completely converted to its OP diester metabolite in PBs but not in RSs suggesting species-specific differences. Alkyl-substituted TPHP analogues also showed that the number and position of the phenyl ring substitution heavily influenced the rate of metabolism. The results demonstrated that OP triester bioaccumulation and fate in PBs versus their RS prey is substantially influenced by biotransformation.

**TH039** Proteomics of a metabolic simulation system - a look inside rat S9 A. Schiwy, EWMOSIS; B. Thalmann, RWTH Aachen University, Institute for Environmental Research / Bio5 - ESA; P. Huesgen, Forschungszentrum Jülich GmbH / Central Institute for Engineering, Electronics and Analytics (ZEA); S. Schiwy, Institute of Environmental Research-RWTH Aachen / Department of Ecotoxicology / Bio5 - ESA; H. Oettel, RWTH Aachen University / Institute for Environmental Research

The liver is the key organ in metabolism and detoxification of xenobiotics. Simulation of this organ in various bioassays is achieved via the application of either single cytochrome P450 enzymes produced via biotechnological processes or complex enzyme mixtures obtained from animals. Especially, this second process is regarded under various animal welfare regulations as an animal experiment. The liver rather than the organ (predominantly liver) for further downstream processing. The most common procedure is a mixing of various RSs and subsequent species-specific differences. Alkyl-substituted TPHP analogues also showed that the number and position of the phenyl ring substitution heavily influenced the rate of metabolism. The results demonstrated that OP triester bioaccumulation and fate in PBs versus their RS prey is substantially influenced by biotransformation.

**TH040** A critically evaluated database of in vitro and in vivo toxicokinetic data for...
mammals and fish

J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; A. Looky, ARC Arnot Research and Consulting Inc.; K.L. Foster, ARC Arnot Research and Consulting Inc. / Adjunct Professor, Trent University, Applications of Modelling & Quantitative Methods (AMQD); J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; M. Halder, European Commission Joint Research Centre / DG Joint Research Centre IHC EUR V ECVAM; A. Lostia, European Commission Joint Research Centre; A. Kienzler, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EURL ECVAM

Toxicokinetics (TK) plays an important role in ecological and human health assessments. TK models require TK data on chemicals, including chemical models of bioaccumulation of chemicals subject to regulatory assessment requirements. It is not feasible to measure TK data in all organisms (e.g., humans, rodents, fish) and there is a recognized need to reduce animal testing. Reliable (evaluated), high-quality existing in vivo and in vitro TK data could help evaluate in vitro-in vivo extrapolation models (IVIVE), parameterize TK and bioaccumulation models, and develop and validate quantitative structure-activity relationships (QSARs) for predicting TK parameters from chemical structure. Biotransformation and elimination rate data can be used in diverse contexts for chemical assessment. For example, biotransformation rate constants (k\textsubscript{B}) are key determinants and sources of uncertainty in bioaccumulation assessment. k\textsubscript{B} can be determined in vivo with whole animal models or from in vitro assays using intact cells or subcellular fractions from the liver or other tissues (e.g., gastrointestinal tract, kidney). We have developed a new database (funded by the JRC CCR.F.C931336.X0) containing TK data (i.e., biotransformation rates) for fish and mammal species (i.e., rat, mice) derived from in vivo and in vitro (59 fraction, hepatocytes, microsomes) methods. The database entries are scored based on a data quality evaluation. The data quality assessment methods and criteria have been developed from standardized testing guidelines. When there is limited guidance and from professional judgement in the absence of standardized guidance. In total the new database includes approximately 9000 entries for organic chemicals. There are approximately 4000 and 400 chemicals from in vitro and in vivo studies respectively from rodent species. There are approximately 120 and 700 chemicals from in vitro and in vivo studies respectively from fish species. The database can be used as a source of information for chemical assessments and can help identify future research needs (i.e., chemicals that require chemical evaluation and for which reliable quality data are not available). We believe the database will also be a valuable source information for model developers (e.g. for in vivo-in vitro extrapolation models, kinetic models, models to predict exposure and internal concentration in an organism) and chemical evaluators. The database will be publicly available at the Joint Research Centre website.

TH041 A tiered strategy for rapid estimation of bioaccumulation by a combined modelling - in vitro testing approach: derivation of kinetic rate constants for fish

K. Schirmer, Eawag / Environmental Toxicology; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; N. Bramaz, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; N. Bury, University of Suffolk / Division of Diabetes and Nutritional Sciences; M. Halder, European Commission Joint Research Centre / DG Joint Research Centre IHC EUR V ECVAM; R. Fitzgerald, University of Exeter / Biosciences College of Life and Environmental Sciences; C. Hogstrand, Kings College London / Division of Diabetes and Nutritional Sciences; C. Kropf, University of Bern / Centre for Fish and Wildlife Health; H. Segner, University of Bern / Centre for Fish and Wildlife Health; R. Schoenenberger, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; J. Stadnicka-Michalak, EPFL - Swiss Federal Institute of Technology

Our research seeks to improve alternative methods to estimate bioaccumulation of organic chemicals in fish. We follow a tiered strategy that integrates toxicokinetic (TK) models, quantitative structure-activity relationships (QSARs), in vitro exposure and test systems, and TK models into in vitro-in vivo extrapolation methods. In this first step, we derived a set of candidate chemicals for in vivo testing based on model discrepancies, availability of reliable in vivo BCF and BMF data, and availability of in vitro biotransformation rates. The resulting chemicals were divided into three K\textsubscript{BCF} categories based on predominant exposure routes (e.g., diet, gill, liver) and the data used are interpreted for in vitro testing in the following five groups: 1) log K\textsubscript{BCF} < 4 (aquatic exposure dominates – to be tested in gill and liver models); 2) log K\textsubscript{BCF} > 5.5 (mixed exposure routes – to be tested in gill, liver and intestine models); and 3) log K\textsubscript{BCF} > 5.5 (predominantly dietary exposure dominates – to be tested in liver and intestinal models). The bioaccumulation results in now on-going. Specifically, primary gill cell cultures grown on permeable support are used to determine the combined biotransformation/permeation rate through this epithelial model. Primary suspension preparations from hepatocytes and intestine are explored for biotransformation rates (i.e. loss of parent compound). Permanently permeant cellular fractions from gills, liver and intestine, exposed in monolayer, complement the set of in vitro methods applied, yielding parent compound loss rates as well. In vitro models are each applied under their respective optimal conditions, taking e.g., temperature and media composition into account. Chemical starting concentrations are set uniformly for all models based on non-toxic concentrations and analytical method sensitivity. Thus far, permeation/biotransformation was observed for all chemicals applied. The resulting rate constants are subject to comparison between the different in vitro models and are input into the TK and QSAR models for model development and hypothesis testing. This poster will describe the overall in vitro testing strategy, the different in vitro models and the results of the chemical testing with regard to in vitro-derived rate constants.

TH042 Update on development of OECD Test Guidelines and Guidance Document on determination of fish in vitro hepatic clearance


Chemical biotransformation represents the largest source of uncertainty in chemical bioaccumulation assessments, and model-based estimates of chemical bioconcentration in fish may be greatly improved by including biotransformation rates, as measured in vitro. Substrate depletion assays, using rainbow trout hepatocytes (RT-HEP) or liver subcellular fractions (RT-S9), have been successfully developed and are part of the OECD framework for fish biotransformation. We conducted a multi-laboratory ring trial, coordinated by the ILSI Health and Environmental Sciences Institute (HESI), was recently completed which demonstrates assay reliability within and across laboratories and similar performance of substrate depletion assays using the two biological systems. Based on the successful results of this ring trial, two OECD test guidelines (TG) (“Determination of in vitro intrinsic clearance using cryopreserved rainbow trout hepatocytes” and “Determination of in vitro intrinsic clearance using rainbow trout liver S9 sub-cellular fractions”) have been drafted and are accompanied by a Guidance Document (GD). The OECD GD provides detailed information on how to conduct the tests as well as how to apply the measured in vitro biotransformation rates to predict bioconcentration in fish. In addition, guidance on selection of the assay system (e.g., primary hepatocytes vs. liver S9 fractions), specific considerations for testing chemicals, use of negative and positive controls, BCF extrapolation models, and application of the two test methods beyond BCF prediction are also covered. Draft TGs, the GD, and the ring trial report underwent two OECD public commenting rounds during 2017 and submission to OECD WNT final approval is planned for 2018.

TH043 The Bioaccumulation Assessment Tool (BAT): A quantitative weight of evidence approach for bioaccumulation assessment

I. Tseng, ARC Arnot Research & Consulting; J.M. Armitage, University of Toronto - Scarborough / Environmental Toxicology / Environmental Toxicology; K.L. Foster, ARC Arnot Research and Consulting Inc. / Adjunct Professor, Trent University, Applications of Modelling & Quantitative Methods (AMQD); M. Embry, ILSI; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

Bioaccumulation Chemicals are being assessed for bioaccumulation (B) potential in regulatory programs using various methods, metrics and criteria. B data can be obtained from various data streams including laboratory studies, field studies and model predictions using mass balance models and quantitative structure-activity relationships (QSARs). Examples of bioaccumulation metrics include the bioconcentration factor (BCF), bioaccumulation factor (BAF), biomagnification factor (BMF), and bioconcentration factor (BCF). To develop the Bioaccumulation Assessment Tool (BAT) to collect, evaluate and integrate various lines of evidence (LOE) associated with these B-metrics and related B classification criteria to aid decision-making. The BAT provides a transparent and consistent framework for evaluating neutral and ionizable organic chemicals in aquatic and terrestrial organisms. It uses a quantitative weight of evidence (WQE) approach which includes evaluations for the relevance, reliability (confidence) and outcome of each B-metric. Each substantive LOE (e.g., BCF, BMF, biotransformation rate) is subject to data quality evaluation resulting in a data confidence score. The Data Evaluation Templates (DET) have been derived from standard test protocols and expert judgment when standard protocols are not yet developed. Physical-chemical properties can be used or the user is allowed to enter biologically relevant partition coefficients in place of default assumptions that assume octanol as surrogate for biological components (i.e., lipid). Estimates for biotransformation rates can be included from in vitro assays (i.e., S9, hepatocyte, microsomal) and from in silico (QSAR) predictions. Empirical data such as lab BCFs and BMFs and field data as
well as in silico data (e.g., BCF-QSARs) can be included in the QWOE. This presentation provides an overview of the BAT and demonstrates its application with two case studies. The first example is a typical “data poor” scenario in which only chemical structure information is available. From chemical structure relevant physical-chemical property and biotransformation rate data are obtained from QSARs and entered into the system. The second case study is for a relatively data rich example (e.g., 3 lab BCFS, various BCF-QSARs, biotransformation rate QSARs, in vitro biotransformation rates). Future work for improving the BAT is discussed.

TH044 Towards the use of elimination rates in bioaccumulation assessment – Current challenges and future perspectives

G. Treu, German Environment Agency / REACH Chemicals; W. Drost, Federal Environment Agency (UBA) / Chemicals; C. Rauert, Umweltbundesamt / International Chemicals Management

The capacity of chemicals to bioaccumulate in biota is recognized as critical property that contributes to a chemicals risk. The bioconcentration factor (BCF) reflecting the uptake of a chemical from water and the biomagnification factor (BMF) following dietary uptake in fish remain the preferred metrics in bioaccumulation assessment. The test systems are expensive, time consuming and are not suitable for screening purposes. Still, terrestrial bioaccumulation is hardly considered. A comprehensive bioaccumulation assessment should consider both, the aquatic and terrestrial organisms. Recently, it has been suggested that BCF and BMF can be derived by only determining the elimination rate constant (kₑ) experimentally while the uptake rate (kₐ) is estimated. Following this concept the need for animal tests is reduced if the metabolic contribution to kₑ is from in vitroprocesses while the effect of the other pathways (excretion via urine and feces, and ventilation) are estimated with in vitro to vivo extrapolation models. Biotransformation often reduces the extent to which chemicals accumulate in fish and mammals. Thus, a Tier 1.5 can be introduced between Tier 1 (screening based on physico-chemical data) and Tier 2 (exposure studies with animals) where in vivo biotransformation rates (kₑ) obtained from in vitro tests with fish with mammalian cells are extrapolated to whole organisms and then incorporated into existing chemical mass-balance models to predict a BCF or BMF. Only if this model indicates an increased bioaccumulation a potential a higher-tier vertebrate test is then needed. In practice, animal tests are mandatory for chemicals exceeding a certain level of hydrophobicity but may turn out as non bioaccumulative due to metabolisation. A kₑ based extrapolation model allowing to estimate BCF and BMF values by incorporating in vitro kḍv values of different tissues, e.g. gills, liver and gastrointestinal tract, could be serve as alternative screening criterion under REACH. Thethods described in this talk should be able to experimentally cover species differences currently ignored in bioaccumulation regulation. However, uncertainties remain related to the validity of this approach, e.g. for ionic substances, and should be addressed in future research by taking into account specific metabolic pathways. This poster aims at demonstrating current limitations and future needs for the kₑ based bioaccumulation assessment under REACH from a regulatory agency’s perspective.

TH045 SETAC Bioaccumulation Science Interest Group

L.P. Burkhart, U.S. EPA / ORD/NHEERL/Mid-Continent Ecology Division

Advances in evaluating and regulating endocrine disruptors (P)

TH046 Progress of the Japanese Program on Endocrine Disrupting Effects of Chemicals: EXTEND2016

K. Yamazaki, Ministry of the Environment / Environmental Health

The Ministry of the Environment, Japan published its fourth program on endocrine disrupting effects of chemical substances “EXTEND2016” in June 2016. It is developed upon achievements on development of framework, development and improvement of test protocols and implementation of testing and assessment in the preceding program “EXTEND2010”. While basic concepts and framework was inherited from EXTEND2010, EXTEND2016’s focus has been shifting to implementation of testing and assessment and consideration of appropriate risk management measures. During fiscal years 2016-17 progress has been made in development of test protocols, evaluation of existing knowledge, identification of candidate chemicals for testing, implementation of testing and assessment and communication to the public, as well as in international collaborative projects with the United Kingdom and the United States. One of the most significant achievements should be finalization of the data obtained from the medaka extended one generation reproduction test (MEOGRT) for 4-nonylphenol, which are expected to be referred to in regulatory environmental risk assessment. The reproduction tests are being conducted for additional chemicals within the program. Updated progress in testing and assessment under EXTEND2016 will be presented at the Annual Meeting.

TH047 Effects of endocrine disruptors on reproductive health: A new approach to integrating ecotoxicological and human health data

L. Parent, Télé-université / UER Science et Technologie; P. Grigorova, Université TELUQ / Département Science et Technologie; M. Nikolaros, Université TELUQ / Science et Technologie

Exposure to synthetic and natural chemicals is almost inevitable in our daily lives. Some of them raise concerns with their endocrine disruptive potential and possible interference with endocrine system leading to the variety of adverse health effects. It was initially through clusters of presumptions that the potential effects of endocrine disruptors (EDs) on human health and the environment were highlighted. EDs, as a growing source of concern, now need to better document the complexity of the relationship between exposure and effects, hence the development of new evidence-based approaches to better document decision-making in health policy. Among these approaches, we retained the systematic reviews, based on objective methods, to integrate multiple sources of evidence (epidemiology, wild animals, laboratory animals, in vitro and in silico data) relevant to the evaluation. Our project aims to systematically review the data published the last 10 years linking the exposure to EDs (polybrominated diphenyl ethers (PBDE), alkylphenols, bisphenol A (BPA), parabens, phthalates, perfluorinated compounds) with the effects on the development and reproductive health as changes in sex ratio, congenital malformations, sperm quality disruption, alteration of plasma levels vitellogenin, sex hormone levels as well as anomalies of gonad development. 16 701 articles were screened and 744 met the inclusion criteria for the review. The data was extracted from 155 of the final included studies. In these documents, 377 studies were found to be relevant outcomes, confidence in the body of evidence for an effect was rated, and scores are given. In this presentation, we will show what is the strength of the evidence for the association between exposures and (adverse) effect, and we will discuss the role of ecotoxicological studies in the global analysis: prioritizing EDs, understanding mechanisms of action, establishing standards or impact criteria, identifying sensitive biomarkers and biodicators for each of the EDs.

TH048 Pros and cons of fish toxicity tests in detecting chemicals with endocrine disrupting activities

A. KIENZLIER, JRC-EC / F3-Checmical Safety and Alternative Methods

Unit-EURL / ECVM; Z. DANG, RIVM / LIEC CNRS UMR; S. van der LINDEN, JRC-EC

In the last decade, with the increased awareness of potential effect of endocrine disruptors (EDs) on wildlife, fish toxicity test guidelines have been developed by addressing specific endocrine effects (e.g., chemical impact on endocrine and reproductive health as changes in sex ratio, congenital malformations, sperm quality disruption, alteration of plasma levels vitellogenin, sex hormone levels as well as anomalies of gonad development). This has resulted in attempts to develop and validate a battery of ecotoxicological studies and the ROB (risk of bias) analysis was performed for the relevant outcomes, confidence in the body of evidence for an effect was rated, and scores are given. In this presentation, we will show what is the strength of the evidence for the association between exposures and (adverse) effect, and we will discuss the role of ecotoxicological studies in the global analysis: prioritizing EDs, understanding mechanisms of action, establishing standards or impact criteria, identifying sensitive biomarkers and biodicators for each of the EDs.

TH049 Towards developing a listing of reference chemicals for endocrine assay validation

C. Prosser, ExxonMobil Biomedical Sciences, Inc.; M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI)

Comparing to other areas of human and environmental hazard assessment, evaluating the potential for endogenous compounds to interact with endocrine pathways is relatively nascent. However, recognizing the possibility of a public and environmental hazard, many national governments, international organizations, industry bodies, public interest groups and academic institutions established research programs to address the impacts of endogenous substances on the endocrine system. This has resulted in attempts to develop and validate a battery of
tests to screen for endocrine active compounds with multiple publications by both regulatory agencies and academics aimed at identifying appropriate in vitro and in vivo assays. Thus, there has been considerable effort to establish criteria and interpret results for the identification of potential of endocrine active compounds. However, despite all the attention on test development, little consideration has been given to establishing a list of reference compounds to be used in the validation process. Without establishing a set of criteria it may prove problematic to assess interlaboratory variability for the same endocrine mode of action (e.g. estrogenic/androgenic effects). When evaluating the current, validated, assays in OECD Guidance Document 150, there is a great disparity in the reference chemicals selected, and no discussion as to why various chemical was chosen for the validation procedure. Additionally, reference chemical selection is often not considered when proposing an endpoint to be valid. This presents challenges to regulators and researchers in selecting assays with needed sensitivity and/or appropriateness of use. Here, we attempt to identify the parameters that should be evaluated when selecting validation chemicals. These range from simple physical/chemical properties, to more complex information related to a known mode of action. Additionally, reference chemicals used during assay validation should span a range of potencies incorporating both positive and negative controls. Some well accepted and commonly used chemicals are provided as a realistic starting point to compile a set list of reference chemicals for the validation of endocrine assays.

TH050 Assessment of endocrine disrupting properties of pesticides and biocides: data processing to support data analysis
In 2016 the Commission completed an impact assessment to estimate possible health, environmental and socio-economic consequences of adopting different options, formulated as scientific criteria, for identifying Endocrine Disruptors (EDs) under the Plant Protection Products Regulation and Biocidal Products Regulation. JRC developed a central element of this assessment, namely, a science-based methodology to screen over 600 chemicals in about 10 months, including all EU-registered biocides and pesticides. The methodology was based solely on already existing data. To achieve the objective of screening hundreds of substances in a limited time, all retrieved data for a substance (toxicological studies, effects observed, NOAEL, etc.) were captured in an excel template (consisting of 40 columns), developed by JRC, in order to systematically organise the information to then facilitate data-analysis. As a result a large and curated database is available summarising relevant existing data collected for the 600 substances screened. A major accomplishment was the development of an innovative way to process and visually represent the data captured in the excel template as a mean to facilitate the data analysis in a systematic manner and in medium-throughput to ensure meeting the objective defined in the Commission Roadmap of screening 600 substances in a limited time and by using high-quality science-based strategy. Briefly the data collected are re-organised and processed into a data-matrix which is built automatically after the template has been filled. The data-matrix, available for each of the substances, allows getting access to toxicological information available for a certain chemical thus facilitating the data analysis to identify EDs. For instance the data-matrix visually reports if certain toxicological endpoint has been observed across different studies to support evaluation of consistency and reproducibility of toxicity findings. Focusing on all the pesticides and biocides screened (about 400 substances), the data-matrix for all these substances were merged together in order to build a heat-map summarising all the toxicological information collected by endpoint. The heat-map can be used to group chemicals based on the similarity of their toxicological behaviour as a mean to prioritise chemicals for further analysis or to build read-across strategy to fill data-gaps.
TH054 Structural Alerts for Potential Endocrine Disruptors
R. Kühne, N. Ost, Helmholtz Centre for Environmental Research UFZ / Department of Ecological Chemistry; L.A. Baumann, University of Heidelberg / Aquatic Toxicology and Ecotoxicology; H. Segher, German Federal Environment Agency UFZ / Ecotoxicology

Endocrine disrupting chemicals interact with the hormone system. They may trigger adverse effects on organisms. Endocrine disrupters are labelled as substances of very high concern (SVHC) and are subject of regulations as REACH. However, there are so far no internationally harmonised criteria for endocrine activity. Furthermore, the endocrine system is rather diverse. Existing tests are rather expensive, and it is still not clear whether they comprise all relevant pathways. Thus, the number of existing data is limited. In silico tools may provide alternatives at least to allow prioritisation of tests by screening compound lists. This study aimed to identifying structural alerts for potential endocrine disruptors of two relevant hormone systems, estrogen/androgen and thyroid hormones. Chemicals binding to the estrogen/androgen receptors may either yield an agonistic effect by mimicking the hormone, or an antagonistic effect by blocking the receptor site and thus preventing the hormones from binding themselves. Thyroid hormones bind to the ligand binding domain (LBD) of the receptor, and secondly binding of a co-activating protein to a part of the LBD (AF-2) triggers gene expression. Chemicals binding to LBD may again yield agonistic or antagonistic effects, for binding to AF-2 only antagonism is known. However, adverse effects to thyroid hormones can also result from other mechanisms as enzyme/protein interaction e.g. with the transporter protein and aryl-hydrocarbon receptor interaction. Structural alerts to predict chemicals with potential effect on these systems have been developed. For estrogen/androgen systems a database has been refined. The model identifies 91% of the active chemicals, and false negative results are weakly active only. The models for LBD and AF-2 binding only miss one active compound. For other thyroid hormone effects a screening level model detects ca 95% of the known active compounds, but there is suspect of missing compound classes due to the lack of respective experimental data. Particular remark was given to characterize the applicability domain and reliability of the predictions. All models are implemented as automated tools in the software system ChemProp (UFZ Department of Ecological Chemistry 2017. ChemProp 6.6. http://www.ufz.de/coochem/chemprop). Acknowledgment: This study was financially supported by the German Federal Environment Agency, FKZ 3714 63 412 (0).

TH055 Mixtures of endocrine disrupting chemicals disrupt behaviour and thyroid hormone related gene expression in Zebrafish (Danio rerio) larvae

Endocrine disrupting chemicals (EDCs) in the aquatic environment can have severe effects on the health of aquatic organisms as well as human health. Numerous anthropogenic EDCs, such as plasticizers, fire retardants and antibacterial agents, enter aquatic ecosystems from wastewater treatment plants and land runoff. Several of these have been shown to have adverse effects on fish, including disruption of reproduction, neuromuscular and brain functions. Previous studies have mainly focused on single compound exposures or simple mixtures and further evaluation of complex mixtures at low concentrations is needed. Within the framework of the European Horizon2020 project EDC-MixRisk, EDCs linked to adverse effects on neurodevelopment and growth in a pregnancy cohort study have been identified. Mixtures of these chemicals (phthalate metabolites, phenols and PFASs) were synthesized to be tested in a range of in vivo and in vitro systems. The thyroid hormones (THs) are one of the targets of interest as they are essential for brain development and disruption of this axis may lead to alteration of neurodevelopment. The current study aimed to determine the effects of the EDC-mixtures on larval behaviour and to identify disruption of TH-related gene expression in zebrafish (Danio rerio) during early development. Zebrafish embryos were exposed to Mix N and Mix G (mixtures correlated with adverse effects on neurodevelopment or growth in the epidemiological study) for 48h in concentrations equivalent to 0.01x – 100x human levels. Alterations of larval behavior caused by the exposures were studied as an endpoint for neurodevelopment since behavior integrates many biochemical processes and can be an insensitive endpoint. The sub-letal toxicity of endocrine disrupters. Larval locomotion was tracked using the ViewPoint ZebraBox and a protocol of alternating dark/light cycles. Quantitative PCR was used to determine the effects of the EDC mixture on the expression of thyroid related genes. Our results show that acute exposure to the mixtures significantly alter larval locomotion and expression of genes involved in TH signaling, including thyroid hormone receptors *trha* and *trhb* as well as the deiodinases *dio1* and *dio2* at concentrations corresponding to those found in pregnant mothers. These results will be combined with results from other model systems in the EDC-MixRisk project to improve risk assessment of EDC-mixtures.

TH056 Contaminants of emerging concern in the North American Great Lakes: Assessing environmental mixtures in multigenerational exposure studies
N. Cipoletti, St. Cloud State University / Aquatic Toxicology Laboratory; L. Wang, St. Cloud State University; H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

In aquatic ecosystems such as the North American Great Lakes watershed, organisms are exposed to complex chemical mixtures throughout life, producing effects not anticipated in laboratory settings designed to test acute effects of single chemicals. By exposing fathead minnows through three generations, we aim to capture exposure effects during sensitive life stages. Through two separate multigenerational studies, we analyzed the effects of both urban and agricultural co-occurring contaminants at environmentally relevant concentrations in the Great Lakes watershed. Fathead minnows were housed in a flow-through exposure system and propagated for three generations (approximately one year of continuous exposure). Larval fish were analyzed for predator avoidance performance, feeding efficiency, and growth. Adult fish were analyzed for fecundity, biological indices, and endocrinological characteristics (VTG, glucose). Both urban and agricultural exposures resulted in growth alterations between treatments most likely due to density-dependent growth. Urban exposure indicated higher fecundity (both first and second generation) at low and environmentally relevant concentrations as compared to control and high treatments, potentially as a therapeutic hazard associated with the estrogenic nature of the mixture. Agricultural exposure indicated higher feeding and lower endocrinological disrupting effects compared to urban for first generation only, whereas the second generation demonstrated decreases in environmentally relevant concentrations as compared to low and control treated fish, highlighting the differences between adult only exposed fish (first generation) and lifetime exposure (second generation). Urban exposure demonstrated no changes to male plasma VTG (egg-yolk precursor protein), but agricultural exposure demonstrated increases in high exposed male fish (first and second generation) and environmentally relevant exposed male fish (second generation) due to the estrogenic nature of the mixture and exposure during different developmental stages between generations. Results indicate that mixtures, environmentally relevant in composition and concentrations, have the potential to alter growth, lead to reductions in fecundity, and elevated egg-yolk precursor protein in male fish. Potential, yet unknown, consequences to the population level of exposed aquatic organisms may exist and warrant further study.

TH057 Contaminants of emerging concern in the North American Great Lakes: Assessing species sensitivity using environmental mixtures
S. Kohno, St. Cloud State University / Aquatic Toxicology Laboratory; N. Cipoletti, St. Cloud State University / Aquatic Toxicology Laboratory; L. Wang, St. Cloud State University; U. Hasbay, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

Contaminants of emerging concerns (CECs) have been detected ubiquitously in aquatic environments, and their endocrine disrupting effects concern us. We identified typical CECs in rivers associated with agricultural and urban land use in the North American Great Lakes watershed. A mixture of agricultural CECs (AG) was assembled to mimic the environmentally occurring compounds and consisted of 8 chemicals, while an urban CEC mixture (UB) contained 11 chemicals including the known estrogenic compounds, bisphenol-A, estrone and nonylphenol in addition to estrogencies CECS, Minnesota Pollution Control Agency reported that an exposure to CECs in the river water activated a peroxisome proliferator-activated receptor (PPAR)/retinoid X receptor (RXR) pathway in the transcriptome analysis of fathead minnow. Our laboratory found that an exposure to CECs induced a higher incidence of hepatic vacuolization in fathead minnow, which would be an obesogenic effect of CECs via a PPAR/RXR signaling pathway. Two isoforms of estrogen receptor (ERs) of fathead minnow, bluegill sunfish, American alligator or human was examined in the human embryonic kidney 293T cells by quantifying their transcriptional activities using estrogen-response elements and luciferase reporter gene in an exposure to agricultural or urban CECS. Utilizing the same method in vitro, alligator PPAR-gamma and RXR-alpha were examined. Both AG and UB mixtures were estrogenic, however, their estrogenicities varied depending on isoforms of ERs and 4 species. Human ER1 was the most sensitive to AG based on their estrogenicities, while minnow ER1 was the least sensitive to AG. Bluegill ESRI was the most sensitive to UB based on their estrogenicities, whereas BG ES2 was the least sensitive UB in receptors we tested. Both AG and UB CEC mixtures did not activate neither alligator PPAR-gamma nor RXR-alpha. Although further investigations of PPAR/RXR signal are required in fathead minnow, PRAR/GXRXR signals might not be involved in a CECs-exposure inducing a hepatic vacuolization in fathead minnow. These results indicate that efficacious receptors and species differ between CECs mixture, and further endocrine studies of CECs are required for a better understanding and prediction of CEC effects by utilizing a variety of receptors cloned from diverse threatened and endangered species.

TH058
Contaminants of Emerging Concern in the North American Great Lakes: Effects from simple exposures to complex mixtures

U. Hasbay, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

Contaminants of emerging concern (CEC), including pharmaceuticals, personal care products and industrial agents may impact aquatic life. Previous studies have documented enhanced hormone-like effects in fathead minnow larvae exposed to diverse CECs. However, these studies did not consider the complex mixtures of CEC present in the environment. The purpose of the current study was to understand the change in apical endpoints as the complexity of CEC mixtures increases. We tested the hypothesis that as the complexity of CECs in exposures increase, the apical endpoints observed will differentiate from simple exposure endpoints. We assessed the potential of 21 commonly detected CECs on three life stages fathead minnows: embryo (developmental abnormalities, transcriptomics), juvenile (survival, escape performance, feeding efficiency, qPCR) and adult (survival, secondary sex characteristics, nest defense, courtship, boldness, qPCR) after 96-hour flow-through exposures. In addition, we began the process of building a series of complex mixtures to study the CEC effects using neural network methodology. Individual compound concentrations and mixture composition were based on an analysis of nearly 500 water samples collected as part of the Great Lakes Restoration Initiative. Our current findings show that the larval survival was significantly reduced (p < 0.05, ANOVA) by diverse CECs including estrone, desvenlafaxine, and tris(2-butoxethyl) phosphate exposures. Interestingly, exposure to ibuprofen showed a potential therapeutic effect at the medium concentration to assess two divergent treatment technologies of Wastewater and also observed indication of endocrine disruption on our mixture exposure which includes all studied chemicals. We expect that these evaluations will lead us to improve adverse outcome pathway concepts by testing same chemical effects at different life stages of fathead minnows, and forming a linkage between behavioral responses and adverse outcomes.

TH059 Contaminants of emerging concern in the North American Great Lakes: Load reduction and biological recovery after wastewater treatment upgrades

H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory; D. Martinovic-Weigelt, University of St. Thomas / Biology; P. Edmonst, The College of Wooster / Chemistry; T. Minarik, Metropolitan Water Reclamation District of Greater Chicago

Many urban aquatic ecosystems are becoming effluent dominated, resulting in the presence of contaminants of emerging concern and subsequent adverse effects on aquatic wildlife. Despite these dramatic alterations, effluent dominated urban systems support many ecosystem services and are used by the nearby human population for recreation. The Metropolitan Water Reclamation District of Greater Chicago upgraded two wastewater treatment plants (one million cubic meters/day each) to disinfection (UV; chlorination/de-chlorination). The receiving aquatic ecosystem adjacent to these two wastewater treatment plants has been the focus of intense biological and chemical study for the past seven years and provides a unique opportunity to assess two divergent treatment technologies of Wastewater and the also observed indication of endocrine disruption on our mixture exposure which includes all studied chemicals. We expect that these evaluations will lead us to improve adverse outcome pathway concepts by testing same chemical effects at different life stages of fathead minnows, and forming a linkage between behavioral responses and adverse outcomes.

TH061 Towards a multiparameter detection of biological effects caused by anthropogenic micro-pollutants

C.E. Regeard, German Federal Institute of Hydrology; L. Moscovici, The Hebrew University of Jerusalem / Institute of Life Sciences, Department of Plant and Environmental Sciences; G. Reichen, for the detection of a series of biological endpoints: (a) Extraction and pre-concentration of MPs and their possible transformation products in soil or water samples by solid phase extraction. (b) Separation of the extracts using high performance thin layer chromatography (HPTLC). (c) Biological effect measurement of the individual separated constituents by using genetically engineered yeast (Saccharomyces cerevisiae) or bacterial (Escherichia coli) strains suitable for the simultaneous detection of different adverse effects at the same time. Next steps will include (i) the analysis of real samples, (ii) the further development of an advanced sensor platform for the detection of a series of biological endpoints (androgenic, thyroidogenic, genotoxic, dioxin-like effects, effects on the vitamin D and the retinoic acid receptor) was successfully performed by using genetically engineered yeast (Saccharomyces cerevisiae) or bacterial (Escherichia coli) strains. A main goal of our study is to develop tools and methods for a multiparameter effect detection covering a range of potentially adverse biological effects. This can be achieved by the construction of yeast strains using specific fluorescence reporters for the various endpoints to be detected. By coupling these strains with HPTLC and mass spectrometry, a wide variety of compounds with biological activity could be screened simultaneously. The first step of coupling HPTLC with a different but related biological screening method (UV) was used to verify the detection of a series of biological endpoints (androgenic, thyroidogenic, genotoxic, dioxin-like effects, effects on the vitamin D and the retinoic acid receptor) was successfully performed by using various reference compounds. Furthermore, mixing yeast strains with different endpoints yielded to the detection of different adverse effects at the same time. Next steps will include (i) the analysis of real samples, (ii) the further development of an advanced sensor-platform for the detection of a series of biological endpoints (androgenic, thyroidogenic, genotoxic, dioxin-like effects, effects on the vitamin D and the retinoic acid receptor) was successfully performed by using various reference compounds.

TH062 Endocrine disruptors used in polymers in the offshore oil and gas industry

C. Phillips, C. King, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory; D. Martinovic-Weigelt, University of St. Thomas / Biology; P. Edmonst, The College of Wooster / Chemistry; T. Minarik, Metropolitan Water Reclamation District of Greater Chicago

Polymers were analyzed for alteration in specific endpoints (androgenic, thyroidogenic, genotoxic, dioxin-like effects, effects on the vitamin D and the retinoic acid receptor) was successfully performed by using genetically engineered yeast (Saccharomyces cerevisiae) or bacterial (Escherichia coli) strains. A main goal of our study is to develop tools and methods for a multiparameter effect detection covering a range of potentially adverse biological effects. This can be achieved by the construction of yeast strains using specific fluorescence reporters for the various endpoints to be detected. By coupling these strains with HPTLC and mass spectrometry, a wide variety of compounds with biological activity could be screened simultaneously. The first step of coupling HPTLC with a different but related biological screening method (UV) was used to verify the detection of a series of biological endpoints (androgenic, thyroidogenic, genotoxic, dioxin-like effects, effects on the vitamin D and the retinoic acid receptor) was successfully performed by using various reference compounds. Furthermore, mixing yeast strains with different endpoints yielded to the detection of different adverse effects at the same time. Next steps will include (i) the analysis of real samples, (ii) the further development of an advanced sensor-platform for the detection of a series of biological endpoints (androgenic, thyroidogenic, genotoxic, dioxin-like effects, effects on the vitamin D and the retinoic acid receptor) was successfully performed by using various reference compounds.

TH060 Contaminants of emerging concern in the North American Great Lakes: Validation of effects through field-based exposures

V. Korn, St. Cloud State University / Aquatic Toxicology Laboratory; N. Cipoletti, St. Cloud State University / Aquatic Toxicology Laboratory; C. King, H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory; D. Martinovic-Weigelt, University of St. Thomas / Biology; P. Edmonst, The College of Wooster / Chemistry; T. Minarik, Metropolitan Water Reclamation District of Greater Chicago

Agricultural and urban pollutants are an environmental health concern as their presence in aquatic ecosystems often results in increased stress in aquatic organisms. The effects of agricultural and urban mixtures, each having different chemical signatures, have been studied rather infrequently. The objective of these field-based studies was to assess the impacts of agricultural and urban pollutants on the physiology, reproduction, and population health in fish. These studies, both part of the Great Lakes Restoration Initiative, utilized two distinct watersheds; the Maumee River watershed (Toledo, Ohio) was used to study agricultural pollutants, while the Milwaukee river system watershed (Wisconsin) was used to study urban pollutants. Laboratory cultured adult and larval fathead minnows were exposed to water samples from different sites in the two watersheds for 21 days. Adult minnows were analyzed for alterations in hematological characteristics (glucose, VGT, E<sub>2</sub>, 11-KT) and reproduction, while larval minnows were analyzed for feeding efficiency and predator avoidance performance. The Maumee River indicated reduced reproductive capability, as measured by fecundity, at specific sites along the channel where seasonal differences between the two sampling years potentially due to altered contaminant loads during heavier periods of precipitation. The Maumee River demonstrated no changes to larval predator avoidance behavior or other apical endpoints (feeding, growth) indicating that agricultural contaminants pose no/little perceived threat to larval development. Conversely, the Milwaukee River indicated increased reproductive capability, as fecundity increased among downstream sites in comparison to controls. Additionally, urban samples resulted in an increase in larval growth following 21 days of exposure, but did not impact the predator avoidance behavior. The results indicate that agricultural and urban pollutants entering aquatic environments impact fish physiology and reproduction. Further research is underway to determine whether these observed effects have an impact at the population level.
Thyroid hormone receptors alpha and beta for assessing endocrine disruption in environmental samples

Yoel García Herranz, INIA National Institute for Agricultural and Food Research and Technology; E. Sánchez Martínez, Institute of Aquaculture Torre de la Sal-Spanish National Research Council; M. Fernandez-Cruz, J. Navas, INIA - National Institute for Agricultural and Food Research and Technology / Environment: J. Cerdá Reverter, Institute of Aquaculture Torre de la Sal-Spanish National Research Council

Endocrine disrupting chemicals (EDCs) are ubiquitous in our environment and can be found in many products including food/feeds, containers as plastic bottles or metal food cans, cosmetics, pesticides, flame retardants, detergents,… Accordingly, they pose a threat to animal and human health through different exposure routes. In vitro bioassays are valuable tools for detecting and studying EDCs action and provide a sensitive and rapid system to evaluate their potential effects. In addition, the use of non-mammalian cell lines in line with the 3R principles in relation to TG gene promoter, by analysis of the fluorescence microscopy images. Finally, a gene expression assay, using rt-qPCR, was performed over known markers of thyroid disruption to further characterize the involved pathways of endocrine disrupting effect. The zebrafish assay showed to be a sensitive and cost-effective assay to evaluate the potential thyroid disruptor activity of chemicals.

Thyroid disruption screening using zebrafish as vertebrate model

J. Iurrutia, O. Jaka, C. Martí, A. Alzualde, BioBide; A. Muriana, BBD BioPhenix S.L./RD

Endocrine disrupting compounds are frequently found in the environment and have a profound impact on the development and physiology of vertebrate organisms. Thyroid Disrupting Compounds (TDC) specifically affects the function of thyroid hormones, interfering with their synthesis, transport and/or binding, altering important physiological processes. Several environmental contaminants such as polybrominated diphenyl ethers or halogenated organophosphates, used as plasticizer and flame retardant, are suspected to produce a thyroid-disrupting effect.

Given so, chemical manufacturing entities could benefit from cost-effective methodologies for the screening of TDC in order to deselect candidates during the early phase of the development. In this work, we present an assay for the screening of potential TDC using zebrafish embryo. This vertebrate model is extensively used as a bioassay for the evaluation of acute and developmental toxicity, and several assays in zebrafish are described by the OECD guidelines for the testing of chemicals. Besides, the embryo’s small size and transparency allow to carry out fluorescence-based screening assays with medium throughput. In this work, the thyroid hormone disruption potential of several environmentally relevant contaminant was assessed. For this end, an initial acute toxicity assay was performed in order to estimate the EC50 and NOEC of the tested compounds, and subsequently select concentrations with no systemic toxicity. Afterward, change in the thyroglobulin (TG) synthesis was assessed using a zebrafish transgenic line expressing a cytokerin reporter gene in line with the TRβ1 principles in relation to TG gene promoter, by analysis of the fluorescence microscopy images. Finally, a gene expression assay, using rt-qPCR, was performed over known markers of thyroid disruption to further characterize the involved pathways of endocrine disrupting effect. The zebrafish assay showed to be a sensitive and cost-effective assay to evaluate the potential thyroid disruptor activity of chemicals.

Development of reporter gene system for assessing cherry shrimp ecdysone receptor agonists using mammalian cells

K. Chan, The Chinese University of Hong Kong / Life Sciences; Y. Chan, K. Chu, The Chinese University of Hong Kong / School of Life Science

Ecdysoid is a key steroid hormone that regulates growth, development and molting in animals under the phyllum of Arthropod, which includes the insects and crustaceans. The hormone targets the receptor complex which phosphorylates the ecdysone receptor (EcR) and retinoid X receptor (RXR). The activated complex anchoring on the ecdysone responsive element (EcRE) stated on the promoter subsequently initiates transcription of the responsive gene(s). Chemicals act as receptor agonists do not necessarily adopt the structure of the native hormone, as in the case of estrogenic endocrine disruptors. Recently, for insect pest control, synthetic pheromones and insecticides are used as potential endocrine disruptors, which are developed to disrupt ecdysone/receptor signalling. They work as the ecdysone receptor agonists, which cause premature launching of the molting process and subsequently death. Crustaceans, as a subphylum closely related to insects phylogenetically, also adopt this ecdysone signalling system as they share the hormone, hormone synthetics enzymes and the receptors. Thus, these endocrine disrupting insecticides, together with other untested potential endocrine disruptors, may post a threat on the crustaceans. Here we report the development of an in vitro reporter assay for the screening of ecdysone receptor agonist in cherry shrimp. The assay is done by transiently transfecting mammalian cells with plasmid vectors expressing cherry shrimp EcR and RXR, together with a vector carrying a luciferase reporter gene fused to a minimal promoter linked to five copies of EcRE. The results show that the system responses well to the native ecdysone hormones in a dosage-dependent manner. The adaptation of mammalian cells in in vitro assay for heteroreceptor is satisfactory. Three DAH/BAH insecticides were also tested and gave minimal to moderate signals. The results suggest that these DAH insecticides aimed for insect pest control can be potential hazards to crustaceans. More studies on different mammalian cells and comparison study with mixtures of chemicals are being carried out to validate this reporter gene system.

Micro-injection as an alternative for aquatic exposure? A case study in zebrafish embryos with 17α-ethinylestradiol.

E. Michaels, University of Antwerp / Zebrasalb/Debt Veterinary Sciences; F. Lai, University of Antwerp / Toxicological Centre Dep of Pharmaceutical Sciences; L. Vergauwen, University of Antwerp / Zebrasalb/Debt Veterinary Sciences SPHERE; A. Covaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; A.L. van Nuijs, University of Antwerp / Toxicological Centre Dep of Pharmaceutical Sciences; S.J. Van Cruchten, University of Antwerp / Applied Veterinary Morphology, Dep Veterinary Sciences; D. Knapen, University of Antwerp / Zebrasalb/Debt Veterinary Sciences

Pharmaceutical companies have to perform an environmental risk assessment for every drug that is launched to the market. The mandatory tests for potential endocrine disrupting compounds (EDCs) are mainly aquatic toxicity tests. Micro-injection is therefore proposed as an alternative and ecologically relevant exposure route because the yolk of zebrafish embryos contains many lipids, and this route mimics maternal transfer. To be used as an exposure method, micro-injection needs to be characterized and compared to the traditional exposure route via water. As a study on zebrafish embryos exposed to 17α-ethinylestradiol (EE2, an estrogen receptor (ER) agonist) was chosen as a model compound to compare both exposure routes. Zebrafish embryos were exposed either via water or via injection within the first two hours post fertilization (hpf) until 120 hpf. Different endpoints at different levels of biological organization were assessed. Morphological (i.e., different types of abnormalities) and physiological (e.g., heart rate and swimming performance) endpoints were scored, as well as ER binding and qPCR analysis of 14 genes. An LC-MS/MS method was optimized for measuring EE2 levels in medium of the aquatic exposure experiment and the internal dose in embryos after aquatic exposure or injection. The pattern of brain aromatase mRNA expression

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was different between both exposure routes, while vitellogenin (vtg1) and estrogen receptor 1 mRNA levels were similar between both routes after EE2 exposure. At the morphological and physiological level we observed differences as well. However, the degree of ER-binding was similar between both routes from day 1 until day 5. Despite daily refreshment, the EE2 concentration in the medium decreased regardless of the exposure concentration. The internal doses were the highest at the beginning of the exposure for both exposure routes and decreased afterwards in the order of magnitude of the internal dose was also similar between the injection and an aquatic exposure in the μg/L range, which was also seen e.g. for the mRNA expression of vtg1. Based on the dose measurements we can conclude that even if the embryos were dosed with EE2 within the same order of magnitude that there were still different outcomes for some endpoints. Therefore micro-injection is rather a complementary method and not an alternative route for aquatic exposure.

TH068
Vitellogenin expression, ovarian growth and hormone levels are affected by atrazine in the crayfish Procambarus clarkii
G.R. Silveyra, University of Buenos Aires / Dept. of Biodiversity and Experimental Biology, Institute of Biodiversity, Experimental and Applied Biology (IBBEEA), CONICET-UBA, P. Silveyra, Penn State College of Medicine / Dept. of Pediatrics; I. Vatnick, Widener University; D.A. Medesani, University of Buenos Aires / Dept. of Biodiversity and Experimental Biology, Institute of Biodiversity, Experimental and Applied Biology (IBBEEA), CONICET-UBA, E.M. Rodriguez, University of Buenos Aires / Biodiversity and Experimental Biology.

Atrazine, a widely used herbicide, has been categorized as a suspected endocrine disruptor for many years. Although several studies have investigated the effects of atrazine exposure on reproductive function, its safety remains controversial and the mechanisms of its toxicity remain unclear. In this study, we tested the hypothesis that atrazine can affect reproduction in crayfish through dysregulation of vitellogenin expression and hormone synthesis. Adult female crayfish (Procambarus clarkii) were exposed during one month to atrazine at concentrations of 1 or 5 μg/L. At the end of the exposure, ovaries, hepatopancreas and hemolymph samples were harvested for analysis of vitellogenin expression and steroid hormone levels. Ovarian tissue was also sampled for both biochemical and histological analyses. Atrazine-exposed crayfish had a lower expression of vitellogenin in the ovary and hepatopancreas, as well as smaller oocytes and reduced vitellogenin content in the ovary. Despite these effects, circulating levels of estradiol increased in females exposed to 5 μg/L of atrazine, showing that the inhibiting effect of atrazine on vitellogenin production was not related to a lower secretion of sexual steroids; instead, some early stimulating effects of estradiol on vitellogenesis could have occurred. Moreover, in the hepatopancreas, together, our data showed that atrazine exposure was able to inhibit vitellogenin production in the crayfish P. clarkii, altering on the other hand the normal balance of sex steroids.

TH069
Identification of milt-inhibiting hormone and ecdysserotoid receptor sequences in Procambarus pulex and consequences of endocrine disruptor exposures
E. Gismondo, University of Liege

Endocrine disruptors (EDCs) are well known to disrupt the development and the reproduction of exposed organisms. Although this point has been studied in vertebrate models, the limited knowledge of the endocrine system of invertebrates makes the evaluation of EDCs effects difficult. However, invertebrates represent the first point of contact of EDCs, and are crucial for their functioning (e.g. litter degradation, food resource). Moreover, gammarids are hosts of hidden parasites such as vertically-transmitted microsporidia (microsporidia VT), which could be confounding factors in assessment of EDC effects, since microsporidia VT could feminize juvenile males in some Gammarus sp. Consequently, currently, no biomarkers (assessment tools) are available to address the endocrine disruption in gammarids. The present work focused on EDC effects on the milt process of Gammarus pulex, by researching the DNA sequences of two main proteins in the endocrine system of amphipods: the milt-inhibiting hormone (MIH) and the ecdysserotoid receptor (EcR). Next, the expression variations of these two genes have been measured by RT-qPCR after an injection and an aquatic exposure in the µg/L range, which was also seen e.g. for the mRNA expression of vtg1. Based on the dose measurements we can conclude that even if the embryos were dosed with EE2 within the same order of magnitude that there were still different outcomes for some endpoints. Therefore micro-injection is rather a complementary method and not an alternative route for aquatic exposure.

TH070
Use of in vivo and in vitro assays to investigate the effects and bioavailability of endocrine disrupting compounds in sediment on the benthic invertebrate Chironomus riparius
S. Karnatz, RWTH Aachen University / Institute for Environmental Research Department of Environmental Analysis; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research, Dept. of Environmental Analysis; V. Esser, RWTH Aachen University / Physical Geography and Geocology; A. Müller, RWTH Aachen University / Institute for Environmental Research; A. Shuliakevich, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research; H. Hollett, RWTH Aachen University / Institute for Environmental Research.

Sediments act as a sink and source of chemicals in the environment and, therefore, it is of great importance to know how sediment-bound chemicals affect aquatic organisms. The synthetic hormone 17α-Ethinylestradiol (EE2), a component of oral contraceptives, is ubiquitous in the environment and is a known potent endocrine disrupting compound (EDC) that adversely affects aquatic vertebrates (e.g. reproduction) and might exploit the potential of sediment-bound EE2 on benthic organisms. Therefore, our aim is to determine the reliable toxicity of daphnia to BPA. Passive dosing as well as the existing toxicity testing protocol (i.e., spiking with co-solvent) were used to administer BPA to daphnia. Conventional spiking method often fails to control the exposure concentration of (semi-)hydrophobic organic compounds due to the loss of target compounds from sorption to the test vessel and volatilization. Here, passive dosing technique compensates for the concentration loss by using a biocompatible polymer as a reservoir. Moreover, the adverse effect of the only target compound can be considered in this format as passive dosing does not require a co-solvent to dissolve and deliver the target compound in the correct concentration. A silicic O-ring was chosen as a reservoir for dosing BPA to Daphnia magna. The uptake and release kinetics of BPA on the O-ring were investigated until equilibrium. After the concentration of BPA in the test vessel reached equilibrium, we put Daphnia magna (~24h) in it and checked the sub-lethal effect in 48h by following the OECD guideline 202. At the same time, the acute toxicity test by spiking BPA dissolved in methanol (0.01%) was conducted with the same range of BPA concentrations (0-100 µg/L). Through the passive-dosing method, we were able to determine the silicate-water partition coefficient of BPA and control stable concentration over the test period. The uniform concentration of BPA induced the half maximal effective concentration of daphnids at the lower concentration. We expect that the application of this method in a chronic toxicity test will provide more reliable environmental hazard and risk assessment of BPA. Furthermore, this result suggests that passive dosing could be adjusted to less hydrophobic compounds like BPA (log Kow of 3.64).

TH071
Assessing acute toxicity of Bisphenol A on Daphnia magna by passive dosing approach
H. Kwon, Y. Jeong, H. Jeon, S. Kim, KIST Europe / Environmental Safety Group

Bisphenol A (BPA) is a raw material for widely used polycarbonate plastics, but it is known to have negative effects on human health and the environment. It was classified as an endocrine disrupting chemical (EDC), which requires an accurate and reliable toxicity data for robust risk assessment. However, currently available eco-toxicity data (48h-EC50) on Daphnia magna showed a significant discrepancy of 3.9-16.0 mg/L. Therefore, our aim is to determine the reliable toxicity of daphnia to BPA. Passive dosing as well as the existing toxicity testing protocol (i.e., spiking with co-solvent) were used to administer BPA to daphnia. Conventional spiking method often fails to control the exposure concentration of (semi-)hydrophobic organic compounds due to the loss of target compounds from sorption to the test vessel and volatilization. Here, passive dosing technique compensates for the concentration loss by using a biocompatible polymer as a reservoir. Moreover, the adverse effect of the only target compound can be considered in this format as passive dosing does not require a co-solvent to dissolve and deliver the target compound in the correct concentration. A silicic O-ring was chosen as a reservoir for dosing BPA to Daphnia magna. The uptake and release kinetics of BPA on the O-ring were investigated until equilibrium. After the concentration of BPA in the test vessel reached equilibrium, we put Daphnia magna (~24h) in it and checked the sub-lethal effect in 48h by following the OECD guideline 202. At the same time, the acute toxicity test by spiking BPA dissolved in methanol (0.01%) was conducted with the same range of BPA concentrations (0-100 µg/L). Through the passive-dosing method, we were able to determine the silicate-water partition coefficient of BPA and control stable concentration over the test period. The uniform concentration of BPA induced the half maximal effective concentration of daphnids at the lower concentration. We expect that the application of this method in a chronic toxicity test will provide more reliable environmental hazard and risk assessment of BPA. Furthermore, this result suggests that passive dosing could be adjusted to less hydrophobic compounds like BPA (log Kow of 3.64).
Toxic effects of juvenile hormone analogue insecticides, methoprene and fenoxycarb, on cherry shrimp (Neocaridina davidi)

X. Hu, The Chinese University of Hong Kong; K. Chan, The Chinese University of Hong Kong / Life Sciences; K. Chu, The Chinese University of Hong Kong / School of Life Sciences

Crustaceans are a large group of arthropods, and they are the major constituents to aquatic ecosystems that provide a variety of ecological and economic services. Neocaridina davidi, which is increasing quantities of insecticides leached into water bodies, severely affect the health of aquatic environment globally and heighten the adverse impact on the crustaceans. Among these insecticides, juvenile hormone analogue (JHA) insecticides are a kind of endocrine disruptors known to interfere with the natural hormone action in insects by mimicking the juvenile hormones. However, the structure and functions of the methyl farnesoate (MF) in crustaceans are similar to the juvenile hormone (JH) in insects. Therefore, the exogenous JHA insecticides would cause adverse effects on the development and reproduction in crustaceans as in insects. The aim of our study is to examine the toxic effects of JHA insecticides - methoprene and fenoxycarb on a freshwater shrimp Neocaridina davidi which is successfully cultured and maintained in our laboratory as a new crustacean model. These insecticides are growing in use in agriculture both locally and globally, and their impact to the aquatic ecosystem is needed to be further clarified. In the present study, the acute and chronic toxicity effects of two juvenile hormone analogue insecticides, fenoxycarb and methoprene, on newborn N. davidi were investigated. The 24h and 48h median lethal concentrations (LC50) of fenoxycarb and methoprene were 1.40, 0.97 mg/L (4.64, 3.20 mmol/L) and 1.96, 1.26 mg/L (6.32, 4.05 mmol/L) respectively. The total number of molts of 20 shrimp over this period reduced by 29.2% and 17.7%. Differential expressions of JH signaling pathway genes were assessed in this study. The genes hj3 (hormone receptor 3) and cj75 in N. davidi were up-regulated, while Chdh4 (calponinlike protein), CHH (crustacean hyperglycemic hormone), e74, JHE (JH esterase), JHEH (JH epoxide hydrolase) and JHAMT (JH acid methyltransferase) were down-regulated in shrimp treated with fenoxycarb and methoprene. The results indicate the interference of these two JHA insecticides on the juvenile hormone system.

TH073 Development of Multimedia Fate Model for Human Risk Assessment of EDCs in the Asian Lake Watershed, Korea

M. Choi, J. Kim, Greenecos Inc; Y. Kim, Greenecos Inc / CEO

Multimedia fate model (multimedia fate model for H/man Risk Assessment in Multimedia Environment) has been developed considering topographic features and environmental and been meteorological data of watershed region of Asan Lake in Korea. Human risk assessment system using this multimedia fate model was established and integrated to assess spatial exposure and risk about human living in this area. For this purpose, first, GIS database system considering of environmental and meteorological data of hazardous chemicals was developed. Second, Environmental concentrations of various chemicals were predicted, applying different fate processes according to different chemical properties. Third, advection and dispersion by wind in air grids, runoff in watershed, flows of water in water segments are considered in the watershed-based multimedia fate model, which was linked to a risk assessment system for multimedia pollutants and multimedia Disrupting Chemicals and assesses human risk in this area. HURAME is valuable tools for predicting the fate of chemicals in evaluative and real environments with areas consisting of many watersheds. These models are an integral component of exposure assessment and risk assessment strategies, and are used in detailed assessments of contaminant fate. The aim of these models is to describe quantitatively contaminant fate and migration in a defined watershed region, with water segments and air grids inside of the region of interest treated more complicatedly. As a result, regional levels of environmental contamination are controlled by environmental parameters and processes and meaningful evaluation requires assessment of contaminant fate in neighboring regions. A linked set of regional models are used to describe quantitatively the impact of chemical emissions over a wider geographic scale with significant spatial differences in environmental characteristics and chemical use patterns.

TH074 Comparative toxicity and endocrine disruption potential of urban and rural air particulate extracts on the JEG-3 human placental cells


Outdoor ambient air particulate matter and road pollution are related to adverse effects on human health. The present study assesses the cytotoxicity and ability to disrupt aromatase activity of organic PM; extracts from rural and urban areas at equivalent air volumes from 2 to 30 m³, in human placental JEG-3 cells. Samples were chemically analysed for particle bounded organic compounds with endocrine disrupting potential, i.e. PAH, O-PAH, phthalate esters, but also for organic molecular tracer compounds for the emission source identification. Rural samples collected in winter were cytotoxic at the highest concentration tested and strongly inhibited aromatase activity in JEG-3 cells. No cytotoxicity was detected in summer samples from the rural site and the urban samples, while aromatase activity was moderately inhibited in these samples. In the urban area, the street site samples, collected close to intensive traffic, showed stronger inhibition of aromatase activity than the samples simultaneously collected at a roof site, 50 m above ground level. The cytotoxicity and endocrine disruption potential of the samples were linked to combustion products, i.e. PAH and O-PAH, especially from biomass burning in the rural site in winter. Exposure of zebrafish embryos to the same organic PM extracts led to significantly higher mortality in high mortality rate in the highest test dose compared to rural and urban air particulate extracts. A general inhibition of gene expression implicated in basic cellular functions, such as cell proliferation. Moreover, the embryo transcript analysis showed strong correlations between the Aryl Hydrocarbon Receptor signalling pathway and PAH concentrations. On the other hand, in the zebrafish embryos exposure experiment, the urban samples showed an induction of oxidative stress related genes, which suggest different potential adverse outcomes for exposure to air pollution from specific sources.

TH075 Dietary and non-dietary prenatal exposure to endocrine disruptors (BPA and DEHP). Spanish case study

M. Mar, INDEE RODRIGUEZ, J. Rovira, Universitat Rovira i Virgili; R.P. Sharma, Universitat Rovira i Virgili / Department d Enginyeria Química; M. Nadal, Universitat Rovira i Virgili / School of Medicine, IISPV; V. Kumar, Universitat Rovira i Virgili / Departament d Enginyeria Química; M. Schuhmacher, Rovira i Virgili University / Departament d Enginyeria Química

Endocrine disruptors (EDs) are chemicals compounds that send confusing messages causing various dysfunctions by mimicking or altering the effect of hormones in the human body. Several EDs such as Bisphenol A (BPA) and di(2-ethylhexyl) phthalate (DEHP), are involved in obesity and diabetes diseases in children. Recent studies have shown evidences that these chemicals can cross the placental barrier making fetal exposure closely related to maternal exposure. The aim of this research is to establish fetus exposure to EDs (BPA and DEHP). To address this issue, recently, pregnant women recruitment has begun. In present work, dietary and non-dietary (dermal, non-dietary ingestion and inhalation) exposure of these women was considered in order to predict the dose of EDs at which the child has been exposed in the early stage of the development. The data obtained from this cohort (such as, physiological data, dietary habits and lifestyle, among others) was implemented into a physiological based pharmacokinetic (PBPK) model, which assesses the absorption, distribution, metabolism and excretion of a chemical compound into human body, as well as the internal exposure to target organs. To estimate the early exposure of the child, the model was implemented with fetus compartment for these chemicals. Results indicates that for both, BPA and DEHP, diet is the main contributor to the total exposure. However, indoor environment and dermal exposure also contribute significantly to the total DEHP exposure. Levels of both EDs were modelled in maternal blood and in fetus blood as well as in other body compartment. These results will be validated with the results of biological monitoring in the current cohort (n=72). The integration of the data obtained from current on-going human biomonitoring campaign and the physiological based pharmacokinetic model, here implemented, could predict the early exposure of the child/fetus to EDs. This work is included in the frame of HEALS project (FP/7-603946).

TH076 Sensitive Biomarker Assay using LC-MS/MS: Determination of Thyroid Hormones (T3 and T4) in Fetus, Pup and Adult Rat Serum - Sampling Considerations

S. Diaram, Enviroyo / Bioanalysis (LC-MS/MS)

The regulatory need for the analysis of circulating levels of thyroid hormones in rats (fetus, pup and adult) on reproductive toxicology studies has prompted the need for a sensitive assay for T3 and T4, which could not be fulfilled when using the traditional triiodothyronine (T3) and thyroxine (T4) radioimmunoassays. A sensitive and accurate method validated utilzes a 50 µL sample volume of serum to determine both T3 and T4. This sample volume allowed the development of a sensitive and accurate method, with an LOD of 0.04 ng/mL for T3 and 0.10 ng/mL for T4. The linearity range for both hormones was 0.05-40 ng/mL. The correlation coefficient (r2) for the standard calibration curves were 0.997 and 0.994 respectively for T3 and T4. Moreover, this method was able to determine the lowest concentration of T3 and T4, which could not be done by other methods, 0.04 ng/mL for T3, and 0.10 ng/mL for T4. The method validated utilizes a 50 µL sample volume of serum to determine both T3 and T4 from the same sample aliquot. Across several studies from various Toxicology facilities, it has been observed that T3 and T4 are particularly prevalent in fetus and Day 4 of age pups. Considering that samples are collected from animals of fetus and Day 4 of age pups, which may be triggered for analysis subsequent to Day 13 and adult male samples being analyzed, the emphasis of the integrity of the sample is paramount to
ensure meaningful data can be collected. An experiment was performed to evaluate if tubes containing clot activator could produce ‘cleaner’ serum samples to avoid loss of data points from analytical instrument signal suppression, yet provide true and accurate data without significant loss of T3 and T4 arising from potential absorption or non-specific binding to the clot activator tube. The CV (precision) and RE (accuracy) for both T3 and T4, across quality control samples (generated from collection tubes (a) and (b)) were within acceptance criteria of ≤20% (25% for the LLOQ) demonstrating that tubes containing clot activator can be used for T3 and T4 sampling.

TH077
Steroid estrogens and estrogenicity testing in dairy farm watersheds regardless of effluent management practices
L.A. Tremblay, Cawthron Institute; J.B. Gadd, NIWA / Department of Chemistry; G. Northcott, Northcott Research Consultants Limited

Steroid estrogens contamination has been linked to adverse effects on aquatic biota. Steroid estrogens are excreted by all mammals and are therefore found in most agricultural wastes including dairy manure and dairy shed effluent (DSE). Some previous studies have demonstrated elevated levels of free and conjugated estrogenic steroids in DSE and this source has increased as New Zealand has experienced rapid expansion and intensification of dairy farming. This research used an approach incorporating analytical chemistry and bioassays to evaluate the levels of estrogenic activity in environmental samples from representative dairy watersheds with differing DSE management practices: either milked or not milked. The toxic for fertility, disruptive for endocrine activity and steroid estrogens were prevalent in the waterways within all the studied dairy watersheds. Estrone was the predominant steroid measured in watershed waters because of its presence in dairy cow wastes and as a degrade of the main dairy cow estrogen, 17α-estradiol. Measurable estrogenic activity (17β-estradiol equivalent (Eeq)) was present at low levels in 85% of all stream samples (highest 1.44 ng L–1 Eeq) and all samples were positive for estrogen ultrastructure (≥0.15 ng L–1 Eeq). Whole estrogenic activity was generally ~1, one (of 10) stream with measurable estrone, 17α- and 17β-estradiol had activity of 1.4 ng L–1, a level potentially harmful to aquatic biota. Comparable steroid estrogen concentrations and estrogenicity activity were found whether DSE was spray irrigated on farm paddocks or directly discharged into waterways. This suggests that direct access of cattle to streams, the direct input of DSE into waterways and runoff from land application all require more intervention and effective management.

TH078
Toxic receipt: Why You Should Avoid it?
L. Milas, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; V. Mart, J. Randjelovic, L. Šojić, ALHem - Safer Chemicals Alternative

Bisphenol A (BPA) is at the moment one of most commercial chemicals at global scale and is used in production of thermal papers as a color developer. BPA is not chemically bound to paper, so in contact with skin, it migrates into the skin, and is absorbed. This chemical is proved to be toxic for fertility, disruptive for endocrine system, it can cause allergic reactions on skin and respiratory irritation, and it can lead to serious eye injury. In December 2016, the European Commission made a decision to ban, i.e. restrict use of bisphenol A in thermal paper, if concentration of the chemical equals or exceeds 0.02 mass %. This decision shall be applied as of 2 January 2020. During 2017, ALHem carried out the campaign “Toxic receipts” in order to check the presence of BPA in thermal paper from public and private sectors in Serbia, as well as on paper and plastic packaging for food, comprising 33 samples, out of which: 20 thermal papers (mostly cash receipts), 6 plastic boxes and 7 paper packages for food. The results indicated that all samples of imported thermal paper (rolls) tested in laboratories were positive on the content of BPA. In addition, 87.5% of thermal paper from private sector and 88.9% from public sector contains this chemical. BPA was present in samples in the range of 0.63 and 0.91% (w/w). In this campaign, food packaging was also tested, primarily the one used for packing of fatty food. BAP is soluble in fats so it easily migrates from the packaging into food, which is corroborated by the data that greatest intake of this toxic chemical by humans is by peroral route, i.e. by food. The obtained results indicate that tested plastic boxes for food from supermarkets did not contain BPA. When it comes to paper packaging, French fries bags did not contain BPA, while plastic boxes for food from supermarkets did not contain BPA.

Risk assessment of Nanomaterials: innovative approaches and application of recent research developments to regulatory science (P)

TH080
Evaluate the ecological risk during product development: safe by design case study - Met@link project
R. Janssens, VITO / ARCHE; J. Mertens, Precious Metals and Rhenium Consortium c/o EPFM

As part of the REACH Substance Evaluation for silver, new data was required to be generated to further justify the read-across from ionic silver to silver nanofeatures (SNFs). Information on aquatic and soil ecotoxicity of the smallest silver nanoform with the highest specific surface area registered under REACH as compared to ionic silver. The tested nanoform shall be sufficiently characterised; Information on the fate of nanosilver in soil only in case any of the ecotoxicity tests show higher toxicity for nanosilver as compared to ionic silver. Information on the uses for each individual nanofeature registered under REACH. An ecotoxicity testing programme was therefore undertaken comparing the effects of nanosilver with silver nitrate using 3 internationally standardised and accepted aquatic ecotoxicity tests: Toxicity to the alga Pseudokirchneriella subcapitata (OECD Test Guideline No. 201); nanosilver was less toxic than silver nitrate. Long-term toxicity to Daphnia magna (OECD Test Guideline No. 211); nanosilver was less toxic than silver nitrate. Toxicity to soil microorganisms (OECD Test Guideline No. 216) in 3 soils representative for the EU; nanosilver was equally or less toxic than silver nitrate. The silver nanoform was fully characterised (aqueous suspension containing approximately 37% nanoparticles with spheroidal-like shape, mean primary particle size 9.4 nm). The dissolution behaviour of the tested silver nanoform was determined in the test media used in the ecotoxicity tests. The nanosilver dissolution behaviour qualitatively explained the observed toxicity. Since the ecotoxicity testing demonstrated that nanosilver was equally or less toxic than ionic silver, further fate testing in soil was not required. The data collection on the uses of the silver nanofeatures covered by the REACH registration dossier showed limited tonnage and use of nanosilver. Furthermore, since nanosilver is transformed to ‘bulk’ silver during its use, there is limited release to the environment. The generated data show that the read-across of toxicity values from ionic silver to nanosilver as a ‘worst-case’ approach is justified and scientifically defensible.

TH082
Revising REACH technical guidance on information requirements and chemical safety assessment for engineered nanomaterials for aquatic ecotoxicity endpoints - recommendations from the EnvNano project
S.F. Hansen, Technical University of Denmark / DTU Environment; S.N. Sørensen, DTU Environment / DTU Environment; L. Skjolding, DTU / DTU Environment; N.B. Hartmann, Technical University of Denmark (DTU) / DTU Environment; A. Bøggild, Technical University / Department of Chemistry

The Environmental Chemical Agency (ECHA) is in the process of revising its guidance documents on how to address the challenges of ecotoxicological testing of nanomaterials. In these revisions, outset is taken in the hypothesis that ecotoxicological test methods, developed for soluble chemicals, can be made applicable to nanomaterials. European Research Council project EnvNano - Environmental Effects and Risk Evaluation of Engineered, which ran from 2011-2016, took another outset by assuming that: “The behaviour of nanoparticles
Engineered nanomaterials (ENM) are used in different products with the consequence that they can be released into the environment during their life cycle. Given the large varieties of ENM, the effort for an individual investigation and assessment would be enormous. Therefore grouping of ENM and read across between different materials is a major target for future risk assessment. In this poster we present practicable approaches that can support the discussion on grouping of ENM regarding their environmental fate in our project. The objective is an understanding on the behaviour of the pristine ENM in aquatic and terrestrial compartments. The transformation (chemical transformation and dissolution) and the transport (mobility and agglomeration) of an ENM in the environment was studied. To predict the exposure potential for the environmental compartments both pieces of information were combined to result in a number code (fate bond = 1 to 5). The fate bond for the water compartment will include a matrix of ENM grouped regarding their potential environmental risk. For example, if the transformation via dissolution and chemical transformation is low in the environmental compartment, the transformation potential of the ENM is low. If the mobility is low and the agglomeration potential is high, the transport is also low. Low transformation and low transport means high ENM exposure potential in this compartment and leads to a number value of “3” in the fate bond. For simplification, in this project water phase and sediment phase are considered as one compartment (water compartment) and therefore transport and mobility affected by e.g. agglomeration and sedimentation are not to be considered in the presented approach. In contrast, for soil systems the mobility was analysed in detail, as important factor for the exposure concentration. For an environmental risk assessment the fate bond is used to create a matrix with three toxicological hazard properties (ecotox bond; present at an additional poster) of an ENM. In this poster, the concept to support discussion on grouping and risk prediction will be presented and discussed by using various ENMs as examples. Keywords: Transformation, transport, fate grouping. Acknowledgement - The results are generated in the framework of the project nanoGRAVUR which is funded by the German Federal Ministry for Education and Research (BMBF) under grant no.: 03XP0002.

TH085 Matrix to predict possible environmental risk of nanomaterials during use

M. Herchen, Fraunhofer IME; K. Hund-Rinke, Fraunhofer IME / Department of Ecotoxicology; C. Nickel, Institute of Energy and Environmental Technology e. V. - IUTA / Air Quality & Sustainable Nanotechnology; D. Kuehnel, UFZ - Helmholtz Centre for Environmental Research; K. Schwirn, German Federal Environment Agency UBA; T. Kuhlbusch, BBAuA

In order to evaluate the ecotoxicological effect of ENM during their life cycle, a practical matrix approach called ecotox bond is used. The ecotox bond groups ENM into a matrix of 25 possible combinations of exposure and ecotoxicological effect. The matrix is based on the combination of chemical transformation and dissolution on the production volume of the ENM, that portion which is relevant for the considered use, use in closed / open systems, and slow / fast release into the environment. The resulting so called “release bond” classes ENMs to ENMs with low release (release bond = 1) to high release (release bond = 3). The release grouping is followed by a detailed description of release scenarios for the considered use. These scenarios allow for unit- and identification at the quantitative and qualitative level how the ENM is emitted. Furthermore, possible sinks become obvious for which the fate and ecotoxicological effect grouping need to be performed. Basically, surface water, sediment and soil are possible sinks in the environment. To simplify the fate grouping approach, surface water plus sediment are here supposed to be a monophase system. Thus, chemical transformation and dissolution are considered as relevant processes for the aquatic fate grouping. Transformation (chemical and dissolution) and transport (agglomeration and movement) are considered relevant processes for the terrestrial fate grouping. The so called “fate bond” classes ENMs to ENMs with low exposure potential (fate bond = 1) to high exposure potential (fate bond = 3). In a next step, release bond and fate bond are combined to a so called “ecotox bond” (5 x 3 risk matrix with 25 possible combinations of exposure and ecotox bonds. These are summarized to three risk groups low, medium and high. The applicability of the approach will be demonstrated by risk grouping of nano-ZnO and nano-TiO2 used in sunscreen products. Keywords: release, fate, ecotox bond

TH086 Concepts for nanomaterial categories regarding environmental hazard and for prediction of their environmental risk as well as proof of principle

K. Hund-Rinke, Fraunhofer IME / Department of Ecotoxicology; D. Kuehnel, UFZ - Helmholtz Centre for Environmental Research; C. Nickel, Institute of Energy and Environmental Technology e. V. - IUTA / Air Quality & Sustainable Nanotechnology; K. Schwirn, German Federal Environment Agency UBA; D. Volker, German Environment Agency; E. van der Zalm, German Federal

in suspension is fundamentally different from that of chemicals in solution. The aim of this paper is to present the findings of the EnvNano project and through these provide the scientific background for specific recommendations on how ECHA guidance could be further improved. Key EnvNano findings such as the need to characterize dispersion and dissolution rates in stock and test media have partially been addressed in the updated guidance. However, it has to be made clear that multiple characterization methods have to be applied to describe state of dispersion and dissolution over time and for various test concentrations. More details on environmental fate information is called for on the specific characterization methods and techniques available and their pros and cons. Based on findings in EnvNano, we recommend that existing algal tests are supplemented with tests where suspensions of nanomaterials are aged for 1-3 days for nanomaterials that dissolve in testing media. Likewise, for daphnia tests we suggest to supplement with tests where a) exposure is shortened to a 3h pulse exposure in daphnia toxicity tests with environmentally hazardous metal and metal oxide nanomaterials prone to dissolution; and b) food abundance is three to five times higher than normal, respectively. We further suggest that the importance of considering the impact of shading in algal tests is made more detailed in the guidance and that it is specified that determination of uptake efficiency on the basis of the transfer of ENM for each commercialized functionalization of the nanomaterials is required. Finally, as an outcome of the project a method for assessing the regulatory adequacy of ecotoxicological studies of nanomaterials is proposed.

TH083 Identifying criteria for environmental risk assessment models at different stage-gates of nano-material/product innovation considering requirements of various stakeholders

S.N. Sorensen, DTU Environment / DTU Environment; S.F. Hansen, A. Baun, Technical University of Denmark / DTU Environment; D. Spurgeon, Centre for Ecology & Hydrology; M. Matzke, NERC Centre for Ecology and Hydrology; K. Schwirn, German Federal Environment Agency UBA; T. Kuhlbusch, BAuA; C. Asbach, Institute of Energy and Environment Technology e.V.

Identifying criteria for environmental risk assessment models at different stage-gates of nano-material/product innovation considering requirements of various stakeholders

TH084 Considerations of nanomaterial's environmental fate to support grouping and environmental risk prediction

M. Herchen, Fraunhofer IME; C. Nickel, Institute of Energy and Environmental Technology e. V. - IUTA / Air Quality & Sustainable Nanotechnology; K. Hund-Rinke, Fraunhofer IME / Department of Ecotoxicology; D. Kuehnel, UFZ - Helmholtz Centre for Environmental Research; K. Schwirn, German Federal Environment Agency UBA; T. Kuhlbusch, BAuA; C. Asbach, Institute of Energy and Environment Technology e.V - IUTA

Engineered nanomaterials (ENM) are used in different products with the consequence that they can be released into the environment during their life cycle. Given the large varieties of ENM, the effort for an individual investigation and assessment would be enormous. Therefore grouping of ENM and read across between different materials is a major target for future risk assessment. In this poster we present practicable approaches that can support the discussion on grouping of ENM regarding their environmental potential in our project. The objective is an understanding on the behaviour of the pristine ENM in aquatic and terrestrial compartments. The transformation (chemical transformation and dissolution) and the transport (mobility and agglomeration) of an ENM in the environment was studied. To predict the exposure potential for the environmental compartments both pieces of information were combined to result in a number code (fate bond = 1 to 5). The fate bond for the water compartment will include a matrix of ENM grouped regarding their potential environmental risk. For example, if the transformation via dissolution and chemical transformation is low in the environmental compartment, the transformation potential of the ENM is low. If the mobility is low and the agglomeration potential is high, the transport is also low. Low transformation and low transport means high ENM exposure potential in this compartment and leads to a number value of “3” in the fate bond. For simplification, in this project water phase and sediment phase are considered as one compartment (water compartment) and therefore transport and mobility affected by e.g. agglomeration and sedimentation are not to be considered in the presented approach. In contrast, for soil systems the mobility was analysed in detail, as important factor for the exposure concentration. For an environmental risk assessment the fate bond is used to create a matrix with three toxicological hazard properties (ecotox bond; present at an additional poster) of an ENM. In this poster, the concept to support discussion on grouping and risk prediction will be presented and discussed by using various ENMs as examples. Keywords: Transformation, transport, fate grouping. Acknowledgement - The results are generated in the framework of the project nanoGRAVUR which is funded by the German Federal Ministry for Education and Research (BMBF) under grant no.: 03XP0002.

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In order to evaluate the ecotoxicological effect of ENM during their life cycle, a practical matrix approach called ecotox bond is used. The ecotox bond groups ENM into a matrix of 25 possible combinations of exposure and ecotoxicological effect. The matrix is based on the combination of chemical transformation and dissolution on the production volume of the ENM, that portion which is relevant for the considered use, use in closed / open systems, and slow / fast release into the environment. The resulting so called “release bond” classes ENMs to ENMs with low release (release bond = 1) to high release (release bond = 3). The release grouping is followed by a detailed description of release scenarios for the considered use. These scenarios allow for unit- and identification at the quantitative and qualitative level how the ENM is emitted. Furthermore, possible sinks become obvious for which the fate and ecotoxicological effect grouping need to be performed. Basically, surface water, sediment and soil are possible sinks in the environment. To simplify the fate grouping approach, surface water plus sediment are here supposed to be a monophase system. Thus, chemical transformation and dissolution are considered as relevant processes for the aquatic fate grouping. Transformation (chemical and dissolution) and transport (agglomeration and movement) are considered relevant processes for the terrestrial fate grouping. The so called “fate bond” classes ENMs to ENMs with low exposure potential (fate bond = 1) to high exposure potential (fate bond = 3). In a next step, release bond and fate bond are combined to a so called “ecotox bond” (5 x 3 risk matrix with 25 possible combinations of exposure and ecotox bonds. These are summarized to three risk groups low, medium and high. The applicability of the approach will be demonstrated by risk grouping of nano-ZnO and nano-TiO2 used in sunscreen products. Keywords: release, fate, ecotox bond

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Environment Agency UBA

The grouping of engineered nanomaterials (ENMs) is being intensively discussed in order to develop approaches that allow an adequate hazard assessment of ENMs while reducing the testing effort or to rank them regarding their environmental hazard. Two approaches differing in their focus have been developed and evaluated with a set of 25 ENMs. Based on systematic testing using aquatic test designs used in regulatory testing, the physicochemical (PC) properties, ion transformation, solubility, fiber morphology and size as ecotoxicological and chemical were identified as relevant parameters. The zeta-potential was considered to be less important. Regarding the parameters ecotoxicity of the bulk chemical, solubility and reactivity we decided upon a pragmatic approach with questions which have to be answered “yes” or “no”. Approach I (ecotoxic flow-chart) is characterized by maximum 24 questions per test, for the parameter “morphology” only fibers and small spherical ENMs are considered. In the ecotoxic-bond every “yes” for an answer gives one point. The points are added together resulting in five groups in a range or band of 1 to 5 which is used for further assessment. The same number of points can be achieved by different properties resulting in groups of ENMs which can differ significantly in their PC-properties. This procedure is considered suitable for the initial prediction of ENMs that are of high concern (e.g. Ag and nano-TiO2). No single parameter is used regarding the environmental fate. Both approaches are considered to be a suitable starting point for further discussions and developments. Besides the definition of threshold values for solubility, fiber morphology and size of small spherical ENMs, further parameters (e.g. attachment of ENMs to algae) have to be explored to improve the consistency of the groups. Regarding the terrestrial ecotoxicity, soil properties seem to reduce the impact of the toxic properties of the ENMs. Currently the prediction of terrestrial toxicity is not satisfactory.

TH087

Forms of released engineered nanomaterials: A systematic assessment in material flow analysis

V. Adam, EMPA Technology & Society Lab / Technology and Society Lab; A. Cabaliero-Guzman, EMPA / Technology and Society Lab; B. Nowack, Empa Swiss Federal Laboratories for Materials Science and Technology / Technology and Society Lab

The forms in which engineered nanomaterials (ENMs) are released to the environment affect their fate and toxicity, two parameters essential to risk assessment. Yet, most of current models assessing ENM releases to the environment do not fully account for the transformations that they undergo before release to the environment. This work consists in the development of a method based on current literature, expert elicitation and probabilistic material flow analysis (PMFA) for modelling the proportions of nano-Ag and nano-TiO2 flowing in developing systems (i.e. those that have been subject to multiple environmental transformations), matrix-embedded (ENM released while embedded in a solid matrix), nanoparticulate (non-transformed, not embedded ENM including free, aggregated and agglomerated ENMs and product-embedded (ENM contained within a whole product, going to solid waste treatment) forms to the environment. Transformations of ENMs in the environment are excluded from the scope of this work. The method models 10 environmental compartments. The ENMs flow from production, manufacturing and use to wastewater treatment (sewer system, wastewater treatment plant and sludge) and solid waste treatment (landfilling, incineration and recycling) before reaching air, soil or surface water. Each mass flow was described with a probability distribution. The variability of the data obtained in the literature was used to assess the width of the distributions. Nano-Ag is released to surface water and soil mainly in transformed forms (61% and 77%, respectively), while nanoparticulate forms dominate the releases to air (60%). Most transformations occur in water. Nano-TiO2 presents contrasting results, as most of the releases to air, soil and water are in nanoparticulate forms (80%, 94% and 99%, respectively). The only transformation indicating a possible conversion of nanoparticles to nanofibers (9%) which ENMs are released constitutes an essential piece of information for the input data to environmental fate modelling. For the first time, a method was developed for a systematic assessment of these released ENM forms. Results show that, especially for nano-Ag, the actual nanoparticulate form represents only a small fraction of the total ENM mass released to the environment, thereby calling for a revision of current exposure levels commonly used.

TH088

Using the SimpleBox4nano tool for predicting the environmental concentration of nanomaterials

J.T. Quik, RIVM / DMG; I.A. Meester, E.A. Bleeker, J. Slootweg, RIVM / VSP; S. Loftis, NERC Centre for Ecology & Hydrology / Shore Section; W. Peijnenburg, RIVM / Center for Safety of Substances and Products

In environmental risk assessment the risk quotient, predicted environmental concentration (PEC) relative to the predicted no effect concentration (PNEC), is a useful indicator for risk of chemicals. The SimpleBox® modelling approach has long been applied in the regulatory framework REACH, as part of EUSES, to calculate PECs. The SimpleBox model was recently extended for use with nanomaterials (SimpleBox4.0-nano), by updating particle specific transport process algorithms and including nanomaterial specific transformation processes, such as agglomeration and dissolution. In this study we show the sensitivity of SimpleBox4.0-nano to newly added process parameters. This shows that in addition to the dissolution model, the attachment efficiency, as well as the concentration of natural particles and their size play a role. In order to use SimpleBox4.0-nano we provide guidance on measuring or calculating the relevant input parameters. Furthermore, we indicate the relevance of the different fractions of PECs as calculated by SimpleBox4-nano for estimating the risk quotient. 1. www.rivm.nl/simplebox4nano 2. Meesters, I.A.J., et al., Multimedia Modeling of Engineered Nanoparticles with SimpleBox4-nano: Model Definition and Evaluation. Environmental Science & Technology, 2014. 48(10): p. 5726-5736.

TH089

Directions of in silico method development to complement the predictive models used in risk assessment of nanomaterials

J.T. Quik, RIVM / DMG; M. Bakker, RIVM / VSP; D. van de Meent, Association of Retired Environmental Scientists ARES / Environmental Science; M. Poikkimaki, M. Dal Maso, Tampere University of Technology / Aerosol Physics; W. Peijnenburg, RIVM / Center for Safety of Substances and Products

There is an increasing need for predictive risk assessment of nanomaterials (NMs) for products that are not yet characterized. In order to fill this need, the development and use of in silico methods for estimating the hazard of NMs and NM-related parameters in exposure modelling seems essential. In order to find the relevant application of new in silico methods, we analyze a selection of currently available human and environmental risk assessment models for NMs. This analysis was done by identifying all the NM-related properties used in these models related to three categories of data: 1) Measured hazard or exposure data, 2) Extrinsic NM Properties, e.g. related to the interaction of the NM with the surrounding matrix, and 3) Intrinsic characteristics specific to the NM, matrix or experimental conditions. This analysis is combined with the current state of Quantitative Structure Property Relationships (QSPRs) development, as a specific set of in silico tools, and we recommend further development of in silico models for predictive risk assessment of NMs. In particular, the use of descriptors related to the interaction between a NM and its surroundings, e.g. the attachment efficiency, is proposed. QSPRs as well as other in silico methods are well suited to fill this gap in predictive risk assessment, under the condition that enough data of reliable quality becomes available.

TH090

NanoScreen - Minimizing the risk associated with nanomaterials used in sunscreen at all lifecycle stages

R. Catalano, Aix-Marseille Université; J. Labille, CNRS; D. Slomberg, Aix-Marseille Université; O. Radakovitch, IRSN; M. Zerrad, Institut Fresnel - Aix Marseille Université; S. Rok, ANSES; C. Andre, EPFL - Switzerland

Among cosmetics and personal care products, sunscreen products are of emerging concern regarding both environmental and human healths. While some organic UV blockers have been evidenced to undergo rapid photodegradation, to induce allergene skin reactions due to dermal penetration, or to cause deleterious effects on marine system, the fate of mineral UV blockers is still under consideration from a regulatory perspective. This is largely related to the potential impact of nanotechnology-based products on both environment and human health. The nano-TiO2, UV-blockers typically used in sunscreen usually consist of rutile nanoparticles coated with a first mineral layer of silica or alumina aimed at blocking the photocatalytic character, and thus passivating the nanomaterial. In addition, the grafting of a second layer of organic coating is aimed at favoring the nanomaterial dispersion in the cream formulation. Once drained from the skin either through bathing activity or everyday usage and cleaning, the nanomaterials contained in the sunscreen can be released to the sea shore. Their behavior in this system is largely determined by this industrial coating and by their initial dispersion in the formulation. This project aims to develop the Eco-design of sunscreens through the development of a full method development to complement the predictive method developed in association with nanomaterials incorporated into the formulation. The fabrication and end of life steps are mainly considered and studied using the following two approaches. In order to estimate the release of nanomaterials from sunscreen in marine environment and the subsequent bioaccessibility to the living organism, we carried a field campaign on three beaches on the french coast. The titanium concentration was measured in the sea water as a function of the number of sunbathers. It is fair to say that the higher nanoparticles concentration in the sunscreen, the higher the release factor. In order to decrease the nanoparticles concentration in the suncream without decreasing the sun protection factor, the filter selection and coating property is a key step. The filter coating determines its dispersion in the cream formulation, and thus the UV ray protection on the skin. In a laboratory approach we aimed to formulate the best filter-cream dispersion, in order to maximise the sun protection factor while maintaining low dose of nanoparticles.

TH091
A new test method to determine the bioaccumulation of manufactured nanomaterials in filtering organisms (Bivalvia) using the freshwater mussel Corbicula fluminea


The identification and scientific assessment of compounds that bioaccumulate in organisms and biomagnify in food webs play a key role within the PBT-assessment. The bioaccumulation potential of compounds is commonly expressed in form of bioconcentration factors (BCF) determined in flow-through studies with fish according to OECD 305. Comparable studies with manufactured nanomaterials (MNMs) are difficult to carry out due to the lack of suitable test systems that allow a permanent and constant exposure of the compounds. MNMs tend to sediment in water and are supposed to be mainly taken up by benthic species in aquatic ecosystems. Different studies have shown that mussels are able to ingest and incorporate MNMs suspended in water. However, existing standardised test methods to investigate the bioaccumulation of substances in mussels have been developed and optimized for soluble, non-particulate substances. Therefore, an alternative test concept was developed allowing to investigate the bioaccumulation of MNMs in mussels under flow-through conditions. First studies were carried out with the freshwater mussel Corbicula fluminea. Using silver MNMs (NM300K) and silver nitrate we were able to compare the accumulation and elimination of ionic and nanoparticulate silver. Mussels were exposed for a period of 4 - 6 days. In both cases steady state concentrations of total silver in the mussel tissue were reached within 24 hours. The quantification of the concentrations of silver in water and tissue samples was carried out by ICP-MS or ICP-OES. The experimental concentrations and water concentrations were used to determine bioaccumulation factors for both test items. In a further study the bioaccumulation of a titanium dioxide nanomaterial (NM 105) was tested. The studies have shown that the new test system is suitable to investigate the bioaccumulation of MNMs.

TH094 Genotoxicity of ZnO nanoparticles. A comparison of methods, tools and mechanisms of action in test experimental models used for human and ecological risk assessment

S. marzzo, ENEA / SSPT-BIOEREC-BES; s. schiavo, ENEA CR; M. olioviero, UC CENIT; S. Parthenope; F. Pachierotti, ENEA; c. arcangeli, ENEA CR; E. Cordelli, ENEA / SSPT-TECS-BIORISC Via Anguillarese, 301, 00123, Rome, Italy; g. leuter, ENEA ZnO nanoparticles are considered among the most toxic ones mainly for their capability to dissolve toxic ions. They are largely employed in many productive sectors and primarily in personal care product formulations and then represent a real threat for humans and the environment. The experimental results obtained in human and environmental risk assessment for the evaluation of ZnO nanoparticles are presented for their possible incorporation into the environmental risk assessment of the ENM (environmental nanomaterials) in aquatic ecosystems. Different approaches (chemical and biological) have been used to carry out these assessments, the most common ones being the aquatic toxicity assays on algae and crustaceans. The genotoxicity of ZnO nanoparticles has been tested in several aquatic test species. A comparison of the methods, tools and mechanisms of action in test experimental models used for human and ecological risk assessment is proposed. Different experimental models and techniques for the genotoxicity of ZnO nanoparticles are described and compared.
The global distribution of certain perfluoroalkyl and polyfluoroalkyl substances (PFASs) in the environment is of concern given their environmental persistence and possible adverse effects. These compounds are known to interfere with a variety of physiological processes. In this study, a new method for the determination of PFASs in aquatic samples (AFFF) was developed. The method is based on the extraction of PFASs from the matrix using a solid-phase extraction cartridge. The cartridge was then eluted with a mobile phase consisting of methanol and water. The eluate was analyzed by liquid chromatography tandem mass spectrometry (LC-MS/MS). The method was validated using certified reference materials. The detection limits for the analytes ranged from 0.02 to 0.1 ng/L. The method was applied to different environmental matrices, including surface water and groundwater. The results showed that PFASs were present in all samples, with concentrations ranging from 0.05 to 2.1 ng/L. The highest concentrations were found in surface water samples, while groundwater samples contained lower concentrations. The method was shown to be suitable for the analysis of PFASs in environmental matrices, and it can be used for monitoring and risk assessment purposes.

TH096
Use of biochars for the sorption of poly- and perfluorinated alkyl substances (PFAS) and heavy metals from contaminated soils.
L. Silvanii, Norwegian Geotechnical Institute; Y. Zhang, NMBU; G. Okkenhaug, A. Botten Smeeby, g. cornelissen, s.e. hale, Norwegian Geotechnical Institute
The contamination of soil with a mixture of compounds represents a worldwide environmental issue. Contaminants in soil can leach to groundwater or be transferred to the food chain by crop uptake and affect safety and quality of food resources. Of particular concern are industrial contaminated soils, which are highly contaminated with both organic and inorganic pollutants. In the present study, four soils with different types of pollution (poly- and perfluorinated alkyl substances (PFASs) and heavy metals) and two different total organic carbon contents (high and low), were used. PFASs are a class of compound characterised by hydrophobic, alkylated, fluorine-saturated carbon-chain with a hydrophilic head attached at a terminal position. The high adsorption affinity and strong hydrophobicity of these compounds make them attractive for the preparation of sorbent materials, such as activated carbon, for this environmental application. In this work, we developed a new method for the determination of PFASs in environmental matrices, including surface water and groundwater. The method was validated using certified reference materials. The detection limits for the analytes ranged from 0.02 to 0.1 ng/L. The method was applied to different environmental matrices, including surface water and groundwater. The results showed that PFASs were present in all samples, with concentrations ranging from 0.05 to 2.1 ng/L. The highest concentrations were found in surface water samples, while groundwater samples contained lower concentrations. The method was shown to be suitable for the analysis of PFASs in environmental matrices, and it can be used for monitoring and risk assessment purposes.

TH097
Perfluoroalkylated acids (PFAAs) in soil and invertebrates (Isopoda) near a fluorocatalytic plant in Flanders, Belgium.
I. Greffen, Systemic Physiological and Ecotoxicological Research (SPHERE), University of Antwerp / Biology; M. Erens, University of Antwerp / Department of Biology; L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)
Perfluoroalkylated acids (PFAAs) have been produced for over five decades. Due to their hydrophobic and lipophilic character, they are suitable for a wide range of applications. However, PFAAs may enter the environment, accumulate in wildlife and may cause detrimental effects. The widespread use of PFAAs has resulted in a global presence. Therefore, the major global manufacturer, 3M, phased out the production of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) in 2002. Nevertheless, these compounds are still detected in high concentrations in the environment and biota. Especially the fluorocatalytic plant which has been characterized by PFOS and PFOA for environmental application. In the present study we measured the concentration of 12 PFAAs (8 perfluoroalkyl carboxylic acids (PFCAs) and 4 perfluoralkyl sulfonic acids (PFASs)) in soil and isopods collected at a fluorocatalytic plant in Antwerp, Belgium. In addition, samples from four other areas were collected, representing a gradient in distance from the pollution source. We tested for both correlations between soil properties (e.g., total organic carbon (TOC)) and PFAS concentrations in soil, as well as correlations between PFAAs concentrations in soil and invertebrates. In the soil, PFBA, PFOA and PFOA were the only compounds that were detected at all sites. Soil concentrations of all other compounds, with exception of PFDA and PFBS, were < LOQ in all sites except for the plant site. Median concentrations of 606 ng/g ww for PFOS and 8 ng/g ww for PFOA were detected in soil at the plant site, which are high compared to what has been reported in previous studies conducted in the area. Furthermore, these concentrations decreased significantly with distance from the plant. However, concentrations did not differ between the three locations that were situated farthest away from the plant. No significant differences in TOC were observed.
observed among the studied sites, but TOC was positively correlated with multiple PFASs, including PFOSA. This is the first time that these compounds were identified in sediments of the Spanish coast.

Distribution of per and polyfluoroalkyl substances in sediments of the Spanish coast

E. Concha-Graña, Universidad de Coruña / Grupo Química Analítica Aplicada (QANAP); L. Viñas, Instituto Español de Oceanografía / Centro Oceanográfico de Murcia; S. Munizetxe, Universidad de Coruña / Analytical Chemistry

Per- and polyfluoroalkyl substances (PFASs) configuration, consisting in an alkylated hydrophobic chain fully or partially fluorinated, hydrophobic group terminated, provides to PFASs simultaneous hydrophobicity and lipophilicity. Their persistence, bioaccumulation and toxicity make them a source of increasing environmental and public health concern. Presence of PFASs in the environment is caused by discharges of wastewater effluents or river flows, urban runoff, atmospheric deposition of volatile precursors and subsequent transformation, or direct application of fire-fighting foams containing PFASs, among others. Samples were collected in two semiconfined coastal areas, one of them an area with high industrial and port activities (Ría de Vigo) and the other one with high touristic and recreational activities (Mar Menor). N-MeFOSA, n-EFOSA and n-EFOSA were extracted from sediments by sonication, cleaned up by dispersive solid phase extraction and the analyzed by LC-LTQ-Orbitrap-HRMS in full mode (Concha-Graña E. et al. 2017). This is the first time that these compounds were measured in these areas. N-MeFOSA and N-EFOSA were not detected in any sample, whereas PFOSA was only detected in two samples, but below the quantification limit. PFOS was measured in 39 % of samples, most of them from Mar Menor. In Ría de Vigo PFOS was detected in a point close to a ceramic factory. Regarding PFOA, this compound was measured at level higher than quantification limit in 2 Mar Menor samples. Sum of PFASs in each sampling point was below 0.4 ng/g in Mar Menor and below 0.1 ng/g in Ría de Vigo, being the total concentration of PFOA similar to the detected in similar areas. Some characteristics of the sediments were taking into account in order to find the correlation between these parameters and the obtained data. Moreover, the environmental risk was evaluated. Acknowledgements: Financial support by the Program of Consolidation and Structuring of Units of Competitive Investigation of the University System of Galicia (Xunta de Galicia) (reference: ED431C 2017/28) potentially co-financed by ERDF, and by the Ministry of Economy and Competitiveness under project reference CTM2013-48194-C3-1-R2-R, and ARPA-ACUA, project reference CTM2016-77945-C3-3-R. References: Concha-Graña E. et al. 2017, Reunion de la Sociedad Española de Espectrometría de masas, V Reunion Nacional de Dioxinas, Furanos y Compuestos Orgánicos Persistentes Relacionados (2017)

Utilization of Polyethylene Passive Samplers to detect volatile PFASs precursors in water and air

E. Dixon-Anderson, R. Lohmann, University of Rhode Island / Graduate School of Oceanography
Oceanography

Fluorotelomer alcohols (FTOHs) and other poly- and per-fluorinated alkyl substances (PFASs) are common and ubiquitous by-products of various industrial telomerization processes. They can degrade into various perfluorinated carboxylic acids (PFACs) including perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), which are persistent organic contaminants of concern. This study assessed the use of polyethylene passive samplers as a sampling tool for volatile PFAS precursors coupled to their analysis via gas chromatography-mass spectrometry (GC/MS). Parallel active and passive sampling was also performed in ambient air in Providence (RI USA) in April 2016. Atmospheric concentrations were dominated by FTOHs (average 9.9 – 16 pg/m³), with traces of other volatile PFASs also detected. Polyethylene-air partitioning constants, log K_{pe}, were estimated. A deployment at a Waste Water Treatment Plant (WWTW) was also performed in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyethylene-water partitioning constants, log K_{pw}, during the 3-week uptake experiments. Derived log K_{pw} values for 6.2, 8.2 and 10.2 FTOHs were 3.8, 4.4 and 4.8, respectively. For MePFOS and EtPFOS, derived log K_{pw} values were 4.0 and 4.4, respectively. 

Based on these partitioning constants, aqueous concentrations in the effluents were below 1 ng/L for the FTOHs, MePFOS and EtPFOS.

TH105 Occurrence and Removal of perfluoroalkyl and polyfluoroalkyl substances (PFASs) in full-scale water and wastewater treatment plants

H. Cihan, M. Wahlund, J. M. M. Skov, F. Ahlgren, National University of Singapore / Civil & Environmental Engineering

Perfluoroalkyl and polyfluoroalkyl substances (PFASs) comprise a group of compounds that are widely used in the markets for stain repellents, polishes, paints and coatings. In recent years, the occurrence of PFASs in the environment has been recognized as emerging environmental problem due to their persistence, bioaccumulative and toxic properties on ecosystems. Unlike most other persistent and bioaccumulative organic pollutants, PFASs are water soluble. Therefore, removal of PFASs by water treatment processes could be a challenge. The objective of this study was to evaluate the ability of different water treatment techniques to remove PFASs from water. In this study, three full-scale water treatment plants were investigated during a one-year monthly sampling for the removal of 31 PFASs, including 20 perfluoroalkyl acids (PFAAs) and 11 PFNA precursors. The treatment processes include conventional activated sludge system (CAS) and membrane bioreactor (MBR) system in plant 1, sand filtration (SF) and membrane bioreactor (MBR) system in plant 2. A deployment at a Waste Water Treatment Plant (WWTW) was also performed in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyethylene-water partitioning constants, log K_{pw}, during the 3-week uptake experiments. Derived log K_{pw} values for 6.2, 8.2 and 10.2 FTOHs were 3.8, 4.4 and 4.8, respectively. For MePFOS and EtPFOS, derived log K_{pw} values were 4.0 and 4.4, respectively. Based on these partitioning constants, aqueous concentrations in the effluents were below 1 ng/L for the FTOHs, MePFOS and EtPFOS.

TH106 Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) occurrence in biota in Czech rivers

V. Kodeš, D. Leoniovyčová, Czech Hydrometeorological Institute / Section of water quality; R. Grubic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses

Objective of the Study The study compares PFOS and PFOA concentrations detected in biota within CHMI bioaccumulation monitoring program of South Bohemia in Ceske Budejovice. Fish samples were collected at 17 sites, 16 of them within South Bohemian District and one site in the Vltava River. The sampling was performed in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyethylene-water partitioning constants, log K_{pw}, during the 3-week uptake experiments. Derived log K_{pw} values for 6.2, 8.2 and 10.2 FTOHs were 3.8, 4.4 and 4.8, respectively. For MePFOS and EtPFOS, derived log K_{pw} values were 4.0 and 4.4, respectively. Based on these partitioning constants, aqueous concentrations in the effluents were below 1 ng/L for the FTOHs, MePFOS and EtPFOS.

Conclusion In general the highest PFOS concentrations were found in liver, fish muscle and blood. PFOS concentrations in fish, body and liver were higher than concentrations found in muscle tissues due to its binding to proteins in a blood and a liver. All collected fish blood samples and more than 50% of collected samples of fish liver and juvenile fish exceeded EQS for PFOA (1.1 μg/L).

TH107 Analytical strategy to study the distribution of perfluoroalkyl substances in fish tissue of Italian deep subalpine lakes


Perfluoroalkyl substances, such as perfluorinated sulfonic acids (PFSSAs) and perfluorinated carboxylic acids (PFACs), are ubiquitous contaminants in the aquatic environment, including wildlife and humans. Perfluorooctanoic acids bind to proteins and the binding of bioaccumulation behaviour differently from that of lipophilic substances. Therefore, conventional methods (fish fillet analysis, lipid normalization, etc.) to monitor their concentrations in aquatic biota cannot be used as such to assess the bioaccumulation and biomagnification of PFCA and PFSA. In this study, conventional monitoring approaches and new strategies are compared to assess the best methodology to be implemented in biota monitoring plans for these compounds. Several fish were monitored in Italian deep lakes. Fish muscle and liver were seasonally collected for the analysis of perfluorocarboxylates, perfluorosulfonates and 5 perfluorosulphonamides. Individual fish were measured, weighed and dissected in three fractions: whole viscera, the muscle and the rest of the carcass (head, fishbone, skin and fins). The fractions of six fish were analysed separately or pooled in one or two samples for the subsequent analysis. The dry weight, the lipid and the protein content were measured in each fish fraction (muscle, viscera and the rest of carcass). PFAS analysis were carried out with fresh samples but some samples of fillet were also freeze-dried in order to compare the concentrations. Extraction of the animal tissues (2-5 g) was performed by sonication with ACN/H₂O mixture enhanced by salting out and acidification; extracts were purified on HydroSPE followed to remove matrix suppression effects by phospholipids. Perfluorooalkyl compounds were determined by liquid chromatography tandem mass spectrometry (HPLC-MS/MS) coupled to an on-line turbulent flow chromatography (TFC) for on-line purification of the extracts. PFAS concentrations in lyophilised samples (expressed on fresh weight basis) are lower than ones determined in fresh samples probably due to evaporation of analytes. The mixed-effect model and were > 1 for C₂F₅, C₃F₇, C₄F₉, C₅F₁₁ and PFDoDA and PFTrDA were the dominant products of various industrial precursors to the apparent biomagnification of perfluoroalkyl acids (PFAA) in the trophic web of the river urban Orge (near Paris, France). A total of 16 PFAs and 40 of their potential precursors (pre-PFASs) including 4 perfluorooctane sulfonamide derivatives, 4 fluorotelomer sulfonates (FTSAs) and 2 polyfluoralkyl phosphates (diPAPs) were used in mass spectrometry (GC/MS). Parallel active and passive sampling was also performed in ambient air in Providence (RI USA) in April 2016. Atmospheric concentrations were dominated by FTOHs (average 9.9 – 16 pg/m³), with traces of other volatile PFASs also detected. Polyethylene-air partitioning constants, log K_{pe}, were estimated. A deployment at a Waste Water Treatment Plant (WWTW) was also performed in 2016, and sampling rates derived from the loss of performance reference compounds. Best-fit curves were used to determine polyethylene-water partitioning constants, log K_{pw}, during the 3-week uptake experiments. Derived log K_{pw} values for 6.2, 8.2 and 10.2 FTOHs were 3.8, 4.4 and 4.8, respectively. For MePFOS and EtPFOS, derived log K_{pw} values were 4.0 and 4.4, respectively. Based on these partitioning constants, aqueous concentrations in the effluents were below 1 ng/L for the FTOHs, MePFOS and EtPFOS.

Conclusion In general the highest PFOS concentrations were found in liver, fish muscle and blood. PFOS concentrations in fish, body and liver were higher than concentrations found in muscle tissues due to its binding to proteins in a blood and a liver. All collected fish blood samples and more than 50% of collected samples of fish liver and juvenile fish exceeded EQS for PFOA (1.1 μg/L).
precursors to the apparent biomagnification of PFCA s, via their biotransformation. In addition, the Total Oxidisable Precursor (TOP) assay was applied to sediments and, for the first time, to biota samples. Results revealed the presence of large proportions of unknown pre-PFAs in sediments/biofilm/leaf litter samples (64-80% of total PFAS molar concentration); this proportion was lower in invertebrates (28-54%) and in fish (15-26%). These results suggest either the biotransformation of precursors in benthic invertebrates and fish or the limited bioaccessibility of unidentified sediment-bound pre-PFAs.

TH109 PFAS and their precursors in the Environment. First indications from a large scale environmental monitoring study M. Maathoff, Fraunhofer IME Environmental and Food Analysis; M.W. Bücking, Fraunhofer IME Institute for Molecular Biology and Applied Ecology / Environmental and Food Analysis; H. Ruedel, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology / Department of Environmental Monitoring; J. Koschorreck, Umweltbundesamt Per- and Polyfluorinated Substances (PFAS) have been an ongoing challenge for the environmental sciences for decades. However, the substance versatility, in terms of chemical classes and physico-chemical characteristics yet hinders a full overview of the spectrum. Due to the differential mobility and degradation pathways, the environmental distribution of individual species is complex and requires massive analytical effort. This obscure situation is even stretched by new molecules from international markets, that already travel around the world as industrial substance or as ingredient of commercial products. Our study set out to apply two large scale multi methods capturing short (e.g. C2 to C6 PFBA), medium and long chain PFAS (e.g. C6 to C14 PFBA and PFPA), and also precursors (e.g. PAPs, diPAPs, FTS, NaDona) and novel molecules (e.g. F-53B constituents) on samples of the German Environmental Specimen Bank. Samples include rain samples, suspended particulate matter samples, fish liver, mussels, tree leaves and needles, deer liver, earthworm and herring gull eggs. Here, we present first detections of the F-53B constituents in bream liver samples afar from production sites, and provide indications on distribution patterns.

TH110 A physiologically based toxicokinetic (PBTK) model describing the bioaccumulation of two perfluorinated substances in rainbow trout (Oncorhynchus mykiss) A. Vidal, Istrea Lyon; R. Beaudouin, INERIS / Models for Ecotoxicology and Toxicology METO; E. Vulliet, CNRS / TRACES Team; E. Rochard, Istrea Bordeaux / UR EABX; J. Garric, Istrea Lyon / UR RIVERLY Laboratoire Ecotoxicologie; J. Koschorreck, Umweltbundesamt Per- and polyfluorinated substances (PFASs) are ubiquitous in the environment, specifically in aquatic systems. While several PFASs are acknowledged to be bioaccumulated by vertebrate species, including fish, their absorption, distribution, metabolism and elimination (ADME) remain incompletely understood yet. The aim of this study is to develop a physiologically based toxicokinetic (PBTK) model to describe the bioaccumulation of two perfluorinated substances in rainbow trout (Oncorhynchus mykiss) exposed through the diet to two selected PFASs, namely perfluorooctane sulfonic acid - PFOS - and perfluorooctane sulfonic acid – PFHxS. Here PFOS is considered as a model compound, as it remains the dominant PFAS in environmental matrices. PFHxS represents an industrial alternative to PFOS, since its addition to Annex B of the Stockholm convention in 2009. Dietary exposure experiments were performed with adult rainbow trout at two water temperatures (7°C and 11°C). Fish were fed zebrafish embryos spiked with PFOS and PFHxS during several weeks. Then, fish were allowed to depurate, in the same tanks, where non contaminated food was supplied daily. During both phases, 5 randomly selected fish were periodically sacrificed for the analysis of the selected PFASs in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in blood were obtained by a simultaneous adjustment to experimental data. Half-lives were estimated for both compounds, in blood, at both conditions. Globally, fish acclimated to the warmer temperature showed faster absorption and elimination rates of PFOS and PFHxS, and their distribution differed between organs, suggesting that temperature represents an important factor in the toxicokinetic profile of PFASs.

TH112 Toxicokinetics of perfluorinated alkyl acids in zebrafish embryo C. Vegors, Karolinska Institutet; G. Johanson, Karolinska Institutet / Institute of Environmental Medicine; M. Näslund, S. Wulff, Karolinska Institutet / Institute of Environmental Medicine IMM; M. Sjödin, M. Hellstrandh, J. Lindberg, E. Vincent, Swedish Toxicology Science Research Centre. Perfluorinated alkyl acids (PFAs) are widely distributed and have been detected e.g. in humans, wildlife and numerous other environmental matrices. These surfactants are highly bioaccumulative as well as persistent and have been associated with several health effects including hepatotoxicity, immunotoxicity and developmental toxicity. The chemical structure of PFAs mainly differ in two ways: the length of the hydrophobic alkyl chain and the hydrophilic end groups. Little or nothing is known how the structure affects the toxicokinetics (TK) (uptake, distribution, biotransformation, elimination) and, consequently, the toxic effects in different organisms. We therefore studied the TK of four PFASs; perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane sulfonate (PFHxS) and perfluorobutanoic acid (PFBAA) in the general freshwater fish (Danio rerio (ZFE), Zebrafish), as well as an alternative test model for toxicity testing. We exposed ZFEs at three concentrations of each PFAS up to 120 hours post fertilization (hpf). The test concentrations were selected from pilot studies at which the highest would cause developmental effects in less than 20% of the embryos. Exposure medium and ZFEs were sampled separately at nine time points. Water samples from chemical controls without ZFEs present were taken in parallel. Mass-labelled internal standards specific for each PFAS were added prior to further sample treatment and analysis by LC/MS/MS. The exposure concentrations in the TK experiments differed by four orders of magnitude (PFOS< PFHxS< PFOA< PFOA). Chemical control concentrations remained constant until 120 hpf for all PFAs tested, ruling out unspecific loss due to adsorption to glass. The time courses of the internal concentrations in ZFE indicated biphasic uptake kinetics with slow uptake before hatching to a faster uptake after hatching. Apparent steady-state concentrations were reached at 96 hpf for PFOS, PFHxS and PFOA, while PFBAA did not reach steady-state within 120 hpf. Moreover, PFOA and PFHxS (sulfonic acid end group) showed a higher bioconcentration than PFOS and PFBAA (carboxylic acid end group). In conclusion, these data indicate that the functional group of PFAs, in addition to the alkyl chain length, may have an important influence on the toxicokinetic processes.

TH113 Role of bioaccumulation in the derivation of environmental risk limits for two perfluorinated substances, PFOA and HFO-DA V. Veng Carlson, RIVM Institute for Safety of Substances and Products; E. Smit, RIVM / Centre for Safety of Substances and Products; P. Wassenaar, National Institute for Public Health and the Environment (RIVM) Environmental risk limits (ERLs) were derived in the Netherlands for the substances perfluorociocanic acid (PFOA) and hexafluoropropane oxide dimer acid (HFO-DA); also referred to as GenX, FRO-902 or PFOS01A. These ERLs serve as advisory values according to the guidance under the Water Framework Directive to set environmental quality standards (EQS) in Dutch policy. For these two PFAS substances, the assessment of the bioaccumulation potential is a key issue in the derivation of the ERLs. The most critical receptors are humans and wildlife, which are not only exposed directly via drinking water, but also obtain a significant part of the total exposure indirectly through their diets. For this purpose, bioaccumulation through the (aquatic and terrestrial) food chains has to be evaluated. This information is amply available for PFOA, but is very scarce for HFO-DA. For PFOA, a typical bioaccumulation behaviour has been observed.

Absorption, metabolism, distribution and elimination (ADME) are concerned as well. For accurate predictions of organic contaminants bioaccumulation it is therefore important to take into account temperature variations. Also, to our knowledge, no study on the effect of the temperature on the ADME of PFASs in fish has been carried out yet. The aim of this work is to determine to which extent temperature affects absorption and elimination rates, and distribution within the fish. Two perfluorinated acid compounds, namely perfluorooctane sulfonate (PFOS) and perfluorohexane sulfonate (PFHxS). Here PFOS is considered as a model compound, as it remains the dominant PFAS in environmental matrices. PFHxS represents an industrial alternative to PFOA, since its addition to Annex B of the Stockholm convention in 2009. Two dietary exposure experiments were performed on adult rainbow trouts (O. mykiss) at two water temperatures (7°C and 11°C). Fish were fed zebrafish embryos spiked with PFOS and PFHxS during several weeks. Then, fish were allowed to depurate, in the same tanks, where non contaminated food was supplied daily. During both phases, 5 randomly selected fish were periodically sacrificed for the analysis of the selected PFASs in muscle, liver and blood. Compound-specific tissue distribution, uptake and elimination rate constants in blood were obtained by a simultaneous adjustment to experimental data. Half-lives were estimated for both compounds, in blood, at both conditions. Globally, fish acclimated to the warmer temperature showed faster absorption and elimination rates of PFOS and PFHxS, and their distribution differed between organs, suggesting that temperature represents an important factor in the toxicokinetic profile of PFASs.
Fluoropolymers, therefore, are distinctly different from the other polymeric and non-polymeric classes of PFAS and should be separated from all other classes of PFAS for hazard assessment or regulatory actions. Grouping all classes of polymeric and non-polymeric PFAS together for restriction or regulation is not scientifically appropriate. Fluoropolymers, as polymers of low concern, are uniquely benign PFAS.

**TH116 Fluoropolymers Are Unique, Low Hazard PFAS Needing Different Analytical and Regulatory Approaches Than Monomeric Fluorinated Substances of High Health and Environmental Hazard**

**B. Henry, T. Kennedy, W.L. Gore & Associates, Inc.; H. Fiedler, Örebro University, Örebro, Sweden**

Fluoropolymers, such as polytetrafluoroethylene (PTFE), differ from other monomeric and polymeric per- or polyfluoroalkyl substance (PFAS) classes, such as perfluoralkyl acids, or polymeric precursors that degrade to them. Fluoropolymers do not demonstrate the same toxicity or physical/chemical/thermal properties as other PFAS. Fluoropolymers, such as PTFE do not meet the criteria of PBT (Persistent/ Bioaccumulative/ Toxic) or vPvB (very Persistent/ very Bioaccumulative) chemical substances, nor do they meet the Persistent, Mobile and Toxic (PM or PMT) substances criteria proposed by the German Environmental Agency, Umwelt Bundesamt (UBA, 2017). As high molecular weight fluoropolymers (e.g., PTFE) are benignly persistent (i.e., not mobile, bioaccumulative or toxic), all “highly fluorinated” substances do not pose equivalent health or environmental hazards and thus should not be regulated as a single class of chemicals. Chemical analytical techniques useful for differentiating one fluorinated substance from another are readily available, reliable, and reproducible and should be employed to identify and quantify those highly hazardous monomeric per- and polyfluoralkyl substances (PFAS) individually, rather than techniques aggregating all fluorine containing substances into one group (e.g. total organic halogen, and total organic fluorine). Therefore, high molecular weight fluoropolymers, as a uniquely benign class of polymeric PFAS, require analytical and regulatory approaches differentiating them from fluorine-containing substances that present high health and environmental hazards.

**Advances in Soil Ecotoxicology and Risk Assessment of Terrestrial Ecosystems (P)**

**TH117 Challenges and Open Questions in Earthworm field testing**

**J. Völlinger, Eurofins Agroscience Services EcoChem GmbH / Field Ecotoxicology; O. Klein, Eurofins Agroscience Services EcoToc GmbH / Ecotox Field; S. Knaebe, EAS Ecotox GmbH / Ecotoxic Field**

In the risk assessment of plant protection products for in-soil organisms, the earthworm field test following ISO 11268-3 (ISO 2014) is used as the highest tier option. The test protocol is currently under revision and transition to an OECD document under the auspices of UBA (Germany), mainly focusing on improving/testing statistical methods for the test (e.g. effect of replication) and exploring the options to run the test in a dose-response design. In the light of the recently published EFSA opinion on in-soil risk assessment (EFSA, 2017), and with roughly 20 years of experience with the field test under the ISO guideline, other aspects of the test also might require revision, namely: Description of field site requirements (size and orientation of initial earthworm population), e.g. minimum requirements, potentially derived from typical MDD values for a given endpoint, Land-use of the field site (arable fields versus permanent grassland): is there a preferred option, and/or does this depend on characteristics of the substance under test? Site management/maintenance in general (soil cultivation, crop rotation versus minimum disturbance) and more specifically in the case of testing a substance with herbicidal action (impact on vegetation coverage in test-item treated plots vs. plots of positive and negative control). Plot size and distance between neighbouring plots, plot allocation patterns, and plot separation, especially with a view on potential migration of earthworms between plots and on external re-colonization. Testing of persistent substances (e.g. how to establish a plateau concentration in soil)? Toxic reference (positive control): reduced replication for the toxic reference? Alternatives to the standard reference item Carbendazim? Examples and suggestions will be given and discussed in this contribution and areas for further research will be identified. EFSA [European Food Safety Authority], 2017: Scientific Opinion addressing the state of the science on risk assessment of plant protection products for in-soil organisms. EFSA Panel on Plant Protection Products and their Residues (PPR). EFSA-Q-2011-00978, Parma, Italy. ISO, 2014: ISO Guideline 11268-3: Soil quality – effects of pollutants on earthworms. Guidance on the determination of effects in field situations.

**TH118 Regional Differences of the Environmental Risk Assessment of Pesticides in Soil with a special Focus on the European Union**

**I. Kononou, National School of Engineering of Sfax, Tunisia / Laboratory of Water, Energy and Environment; J. Sousa, University of Coimbra / Department of Life Sciences; J. Roembke, ECT Oekotoxikologie GmbH**

The bioaccumulation factors in the aquatic environment appeared to be dependent on the exposure concentration. For both the terrestrial and aquatic food chain, the specific protein-binding behaviour of PFOA requires different methods for normalisation of the concentration values, than those normally applied to hydrophobic substances, i.e. based on lipid and organic carbon. Not only exposure via food, but also the human toxicological threshold value of PFOA itself is dependent on the exposure concentration. Higher safety factors are needed because of the difference in toxicokinetic half-life between humans and laboratory animals, like rats and mice. For HFPO-DA kinetic data are only limited, which hampers the derivation of a human-toxicological threshold. It is further investigated based on the available data for both substances whether these findings for PFOA can be extrapolated to HFPO-DA, taking into account the structural differences between both compounds. Additional experimental bioaccumulation data for HFPO-DA is probably needed to complete the ERL derivation.
In the European Union (EU) the environmental risk of chemicals is regulated in various ways. Probably the most complex approach in place is the one for pesticides, mainly because these chemicals differ from other chemical groups by three reasons: (1) They are intended to harm organisms, i.e. those which are impacting agriculture. However, many of the pest species affected by pesticides belong to the same taxonomic groups being responsible for many soil functions and services. (2) They are also directly distributed in the environment, usually by spraying the soil, but also in various other ways such as a covering on seed material. (3) Since their effects are supposed to act only against the pests, when being applied regularly the amount of pesticides ending up in the environment is high. Due to the long experience with this very detailed approach the results of the EU ERA for pesticides are often taken over by other countries (e.g. in Africa). But is this practice really reliable? This contribution focuses on the soil compartment and tries to tackle the following questions: (1) Can (and if yes: how) regional differences (e.g. regarding ecological or agricultural factors) influence the performance or the outcome of pesticide ERA? (2) How do ecological and agricultural differences influence the pesticide ERA within the European Union? Our findings show that regional differences in abiotic, biotic and anthropogenic factors can affect the fate of pesticides in soil as well their effects on soil organisms, meaning that these differences should be considered in pesticide ERA. Proposals will be made how to improve the ERA process but keep it at the same time practical (e.g. by using a tiered approach). These ideas will include the selection of representative reference soils and test conditions for Mediterranean regions. In addition, we will discuss whether the range of standard test species used so far is sufficient. In this context comparisons such used for regulation. This data of soils as statistically evaluate helpful. Based on the answers to these questions it will be discussed whether (and if yes, how), the ERA of pesticides has to be modified for Mediterranean regions (both inside and outside of the European Union).

TH119

Adaptation of the earthworm field test method: conceptual overview and first results

J. Roebbe, ECT Okotoksiologie GmbH; B. Daniëls, RWTH Aachen University / Institute for Environmental Research Institute; B. Förster, S. Jaensch, ECT Okotoksiologie GmbH; P. Kotschik, Umweltbundesamt / Federal Agency of Environment / Risk assessment for plant protection products; R. Oettermann, RWTH Aachen University / Institute for Environmental Research; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; M. Ross-Nickoll, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; A. Scheffczyk, ECT Okotoksiologie GmbH; B. Scholz Starke, RWTH Aachen University / Institute for Environmental Research Institute; B. Förster, S. Jaensch, TH119

In 2016, the German Federal Environment Agency (UBA) launched a project entitled “Necessary adaptations of the standard Earthworm Field Test” to improve the scientific basis when transferring the ISO 11268-3 (1999) guideline to a new OECD standard. As a first step, a literature search was performed to compile available data from earthworm field tests, both from the open literature and from anonymized data from field trials. This data was statistically evaluated to develop a plan for an earthworm study background. In February 2017, a workshop was held to discuss the outcome of this statistical evaluation and in particular the proposal for a pilot field study test design together with members of the “OECD-GSIS-Earthworm Field Group”. During and after the workshop, the group agreed on a test design including various aspects of statistical robustness, practicality and flexibility. In these discussions various options were checked, all of them with the intention to improve the quality of the output but without increasing the efforts in routine application of the new design. In simulation studies, the number of plot replicates dedicated to either NOEC or ECxderivation were varied as well as the number of samples per plot. Additionally, the number of treatments of the chemical to be tested (carbendazim, because it is the reference substance for earthworm field tests for more than 20 years) was also modified in order to cover a broad range. This study can be considered as the biggest earthworm field studies ever conducted. In April 2017, the pilot study was started in a design with 30 plot replicates. After this pre-sampling two further samplings have been performed and the last sampling will be conducted in April 2018. First results of this project indicate a clear concentration-dependent effect of carbendazim on earthworms.

TH120

Soil ecotoxicology and ecological risk assessment in southern African mining landscapes

M. Mahabir, North-West University / Unit for Environmental Sciences and Management; H. Ejsackers, WUR/NWU

Although there has been a remarkable development in the field of soil ecotoxicology and risk assessment (RA) models, it is debatable if these RA models are representative enough in order to utilise them on larger spatial scales, attuned to specific landscapes and ecosystems worldwide. An example of this is southern Africa where some soil ecotoxicological research has been done. To address this we will present the results of: An inventory of research on the ecotoxicity of metals toward soil life in southern Africa as an example, focussing on southern African soils, soil life and living conditions. The outcomes of an analysis of the geographical surroundings of gold and platinum mine waste deposits in South Africa. The field study of open coal mining in and near a national park in Swaziland It is concluded that there is a limited body of information on southern African soil life, and most of these were laboratory based studies done by a small group of researchers. Future research with regards to incorporating the information available into a soil ecosystem assessment procedure is needed and recommended. It is recommended that a starting point to address this might be the development of a site-specific guidelines for Ecological Risk Assessment (ERAs) taking into account landscapes, vegetation and faunal characteristics. From our studies in the surroundings of platinum and gold mine waste, we conclude that these wastes still contain considerable amounts of other chemical elements. The extraction methods, moreover, result in very alkaline or acidic conditions. Further the mine waste is very fine grained and therefore susceptible for wind erosion. Consequently these wastes, given the prevailing wind conditions in these areas, will be dispersed over a wide area causing risks for organisms in natural and built areas surrounding these deposit areas. The coal mine study illustrates that mining in or around natural protected area cause risks due to the irradiating impacts of wind and surface and ground water dispersal form the mined area. Therefore ERA should start to assess this impacts on the natural ecosystems present in the area, and compare these with the outcomes of a Potentially Affected Fraction of species PAF analysis. 

Key words: soil ecotoxicology, ecological risk assessments, mining, southern Africa

TH121

Establishment of tiered risk assessment approach of pesticides for soil organisms in China

J. Jiang, Nanjing Institute of Environmental Sciences, MEP; J. Zhou, Nanjing Institute of Environmental Sciences, MEP

The aim of the risk assessment for soil organisms is to prevent negative acute or long-term effects on soil functions and functionally most important species. The risk assessment approach established in China considers ecologically relevant groups of soil organisms – earthworms and the earthworm field test. It is a valuable tool to quickly identify those pesticides which do not pose acute or chronic risk (in a certain area of ecotoxicology) on soil organisms – even under worst case assumptions, and to identify those that need more attention and further evaluations. All risk assessments presented are based on Risk Quotients (RQ), calculated by dividing the Predicted Environmental Concentration (PEC) by the Predicted No Effect Concentration (PNEC). This calculation takes into account, that beside the toxicity of a pesticide, the amount of this pesticide in the environment plays a major role when assessing a risk. If RQ > 1, the risk is unacceptable and higher tier risk assessment is conducted. By using the tiered approach, tier 1 exposure analysis employs simple model (PECsoil_SFO_China from NIES) to predict exposure to soil organisms. A higher tier exposure analysis can be applied by refining environmental exposure parameters or using semi-field trial test. Currently, the models PRAESS and CHINAPEARL, which developed by NIES and ICAMA in China, are applicable to predict the exposure concentration at specific depth of soil layer at specific scenarios in China. Proposed test systems for effect assessment include acute toxicity test or reproduction of earthworm, reproduction test, nitrogen transformation test, litterbag test and earthworm field test. The PNEC can be calculated using the endpoint obtained from ecotoxicological studies and corresponding uncertainty factors (UF). Tier 1 risk assessment mainly focuses on the soil acute or chronic pesticide residues. Tier 2 risk assessment mainly focuses on the litterbag test assessment and earthworm field test. We have used this tiered risk assessment approach to assess the risk of more than 40 common used pesticides in China. Keywords: tiered, risk assessment, pesticide, soil organism

TH122

Ecological recovery and terrestrial Non Target Arthropods: abundance, functional roles and networks

M. Haern-Kissling, Eurofins-Mitot; S. Aldershof, Bioresearch and Evaluation; F.M. Thübeck, Eurofins-Mitot

Terrestrial non-target arthropods exhibit a vast array of life history strategies and migration tactics. However, their home range is rather small, and thus, they are a good model group to investigate the factors which influence ecological recovery in risk assessments. Arthropod communities are not stable, but the numbers of species and individuals per species fluctuate over time and space. Part of the variability may be due to the initial disturbance of the arthropod communities which is either intrinsic or due to biological interactions, as individuals are embedded in complex food and interaction networks. However, the recovery of a network depends on the fact that all ecological and functional roles within such a complex entity are still realised by a certain number of species (and their individuals). Usually, only abundance criteria are applied in ecological recovery investigations. For example, if numbers of individuals trapped are similar to a control group on two subsequent occasions, recovery is concluded upon. But if the proportion of one functional role (e.g. predators, parasitoids, pollinators or herbivores) in the focal group is far below the proportion of the same functional group in the control group, recovery is not...
completed, and the stability of the network in focus might be imbalanced. On the other side, abundance might be different to the abundance in the control group, because of a phase shift due to the initial disturbance, but the proportional distribution of functional roles still mirrors the control group. Thus, we feel that pure abundance data are not enough to understand ecological recovery, but suggest to use additional knowledge about the involved species and their interaction network, like the functional roles and their proportional distribution within a community. Investigating the ecological recovery of a community using information from field work and experiments together with additional information about the species and their importance for and embeddedness in the ecological network is of high importance for a better understanding of the ecological recovery of communities.

**TH123** Comparing effects of fludioxonil on non-target invertebrates using ecotoxicological methods from single-species bioassays to model ecosystems A. Hägerbäumer, R. Raschke, Bielefeld University / Animal Ecology; S. Höss, Ecossa / Animal Ecology; W. Traunspurger, Bielefeld University / Animal Ecology

Lower tier toxicity testing used for risk assessment of plant protection products (PPPs) is conducted with single species. Informations from such toxicity tests are, however, limited to direct effects of the respective tested substances. Although the uncertainties regarding the protectiveness of these tests for in-situ communities are known, informations on effects of PPPs on community-level of non-target organisms are scarce. Model ecosystems, i.e. microcosms, are suitable to bridge this gap between single-species tests and field studies since they provide controlled experimental conditions and are able to demonstrate direct and indirect effects of the respective substances. In the present study, single-species toxicity tests and soil-spiked microcosms were used to comparatively investigate the toxicity of the non-systemic fungicide fludioxonil (FDO) on non-target soil organisms. Regarding soil invertebrates, nematodes are among the most abundant metazoan organisms and frequently serve as indicators. However, nematodes are suitable for risk assessments via various assay tools ranging from single-species toxicity tests to field studies, potential effect of FDO on these non-target organisms were assessed using standardized toxicity tests with Caenorhabditis elegans (ISO 10872) in spiked soil exposure and in-situ nematode communities, sampled from microcosms with FDO-spiked soils. In the standardized toxicity tests, FDO inhibited the reproduction of C. elegans dose-dependently, with a chronic 96-h EC50 of 363 mg kg⁻¹ (dry weight, dw) and a 96-h No Observed Effect Concentration (NOEC) of -1 (dw), which is comparable to the 28-d NOEC of Chironomus riparius in sediment (40 mg kg⁻¹ dw) and within the range of the 56-d NOEC of Eisenia fetida (20 mg kg⁻¹ dw) and 28-d NOEC of Folsomia candida (125 mg kg⁻¹ dw). In the spiked microcosms, distinct effects on in-situ nematode communities could be measured, with significantly lowered abundances in spiked soils, (40% and 50% reduction of nematode abundance in soils spiked with 300 and 600 mg FDO kg⁻¹ dw). Overall, this study provides new insights into the impact of the non-systemic fungicide fludioxonil on non-target soil organisms and demonstrated the general suitability of standardized toxicity testing on C. elegans in protecting in-situ communities.

**TH124** To what extent do soil micro-arthropods facilitate OM breakdown in an arable field soil? - Implications on specific protection goal setting for soil risk assessment of plant protection products G. Heinze, Bayer CropScience; J. Hellweg, Agroscope; A. Pulliam (1988). Since that time, a considerable body of work has developed to consider its theoretical implications as well as to identify how it may be manifested under field conditions. Most recently, the concept of source-sink dynamics has been considered within the European Food Safety Authority (EFSA) Opinion addressing the state of the science on risk assessment of plant protection products for non-target arthropods (EFSA, 2015). This presentation reviews the available literature that investigates the theoretical implications of source-sink dynamics as well identifying the relevant available evidence from both experimental systems and field observations, primarily in relation to non-target arthropods in an agricultural environment. Consideration of this information clearly shows that metapopulation dynamics are generally more complex than presented by the simple source-sink model as originally proposed and that they are very much species/context dependant. However, this issues does raise important questions prompted by the wider condition that it may be manifested under field conditions. Most recently, the concept of source-sink dynamics has been considered within the European Food Safety Authority (EFSA) Opinion addressing the state of the science on risk assessment of plant protection products for non-target arthropods (EFSA, 2015). This presentation reviews the available literature that investigates the theoretical implications of source-sink dynamics as well identifying the relevant available evidence from both experimental systems and field observations, primarily in relation to non-target arthropods in an agricultural environment. Consideration of this information clearly shows that metapopulation dynamics are generally more complex than presented by the simple source-sink model as originally proposed and that they are very much species/context dependant. However, this issues does raise important questions prompted by the wider condition that it may be manifested under field conditions. Ultimately, we aim to link the typology of uncertainties in ERA to risk management techniques, in order to help ERA practitioners to better understand the interplay of uncertainty and risk management, and to make the right decisions.
Derivation of soil threshold concentrations for arsenic: consideration of bioavailability through combination of ecotoxicological and analytical data

The application of the CPCAT approach reduces the different methods and discusses the implications for data analysis and treatment. This involves the performance of field assays assessed with an extensive meta-analysis of field study data. Raw data of biomass and abundance on sample level (0.25 square metres) were extracted from original study reports and assessed on sample and plot level. In total, data of 17 different earthworm species, ecological and morphological groups as well as total abundance and biomass for 1-3 treatments and 3 sampling dates after application within test duration of one year were analysed. This led to a total of 4215 comparisons for the detection of differences between control and treatments. We demonstrate that the distribution of both endpoints abundance and biomass can be described by a Poisson model, which is a requirement for the application of CPCAT (variance homogeneity often not fulfilled in toxicity tests is not a prerequisite of CPCAT). The number of endpoints showing a significant difference between control and treatment was compared to the outcome of parametric test procedures (pairwise t-test, Dunnett and Williams t-test for multiple testing). The study reveals that the application of standard multiple testing procedures leads to a disguising of possible effects due to relatively high differences to be achieved between control and treatments. This consequently results in uncertainties regarding the actual level of effects at the NOEC. The CPCAT approach offers a more powerful and statistically appropriate way of selecting soil field studies because data distribution and variance are adequately considered and smaller differences between control and treatments can be detected.

Relationship between soil microbial biomass methods used in environmental fate laboratory studies

The determination of microbial biomass activity is a pre-requisite for OECD laboratory studies that are designed to investigate the environmental fate of chemicals in soils. By determining soil microbial biomass prior to, during and after a study, the viability and suitability of the experimental soil can be demonstrated. Choosing the appropriate methodology for soil microbial biomass is critical for conducting successful environmental fate studies. One common method, referenced in the OECD guidelines, for determining soil microbial biomass is critical for conducting successful environmental fate studies. Other common methods that can potentially distinguish between active and non-active components of the biomass are not covered. As noted in OECD 14240, substrate induced respiration can be used to estimate the active biomass, whereas in OECD 14240:2-1997, filamentous fungi can extract carbon from both active and non-active biomass components. With such differences between methods, it is important to consider which method is more appropriate for determining soil suitability for environmental fate laboratory studies. Work is currently being undertaken by Smithers Visient to investigate the relationship between the soil microbial methodologies commonly used for laboratory soil studies. The aim of this work is to better understand how the choice of soil biological methods relates to soil viability, which will ultimately facilitate and refine our choice criteria when choosing soils for environmental fate studies.
The population dynamics experiment is a one-year study assessing the dynamics of *Folsomia candida* in artificial OECD soil at constant 20°C. The study started with 25 individuals of different age classes in 100 g OECD soil. Since then the population increase was measured on at least a monthly basis with five replicates per testing day. The food regime is adapted to the increasing population density to make sure that the maximum population level is achieved during the study. We will show a fast growth at the beginning of the experiment and expect to reach an oscillating population size around its maximum capacity at the end of the study. In a second experiment the vertical dispersal of *F. candida* in relation to food location is investigated. Transparent PVC columns were filled with average 350 g of OECD soil up to a level of 20 cm soil column height and 86 *F. candida* of different age classes. Each column was closed with Parafilm on top and a gauze on the bottom with a small water reservoir beneath it to avoid desiccation. The initial humidity was set to 50 percent of the maximum water holding capacity of the soil. The columns were separated into six compartments at different heights: 1, 2.5, 5, 10, 15 and 20 cm. Septa in the middle (4th) and bottom (6th) compartment allowed for watering and feeding. We varied the location of feeding by four different regimes while all other parameters were kept constant. The columns were provided either with food at the top, in the middle, in the ground or at all three compartments. Our hypothesis is that food is a main trigger for the vertical distribution of *F. candida* in soil. Two of three large examination dates have been processed so far. The data confirms our hypothesis and the results of the study will present new data for the otherwise well investigated Collembola species *F. candida*.

**TH132**

### Why zinc doesn't matter: habitat quality drives invertebrate response to zinc, not concentration

S. Siciliano, University of Saskatchewan / Department of Soil Science; K. Jegede, H. Fajana, University of Saskatchewan / Toxicology Centre

The responses of organisms in soil ecotoxicity tests are often determined by the bioavailable concentrations of contaminants they are exposed to. However, the direct effect of habitat quality on the performance or response of organisms in different contaminated soils is often neglected. Habitat quality is a measure of extent to which habitat promotes individual and population fitness. This study assessed the effect of habitat quality on mite, *Oppia nitens* exposed to different contaminated soils which was corrected for bioavailable metals. Forty-seven (47) soils were ranked into habitat quality by summing up the scores of enchytraeid and *F. candida* survival and reproduction with the plant biomass in each of the soils. From the 47 soils, 18 soils were divided into three habitat quality groups based on high, medium and low habitat quality. The 18 soils were dosed with low to high concentrations of zinc and mites exposed to the soils for 28 days. Mite survival, reproduction, stress biomarkers and bioavailable zinc were determined over 28 days. Habitat quality did not change zinc bioavailability which remained a constant across all three habitat indices. Instead, mite fitness improved with increasing habitat quality and mites were able to tolerate higher zinc body burdens in better habitat qualities. Furthermore, the zinc response (measured as the slope of the EC50) was more pronounced in lower habitat qualities. Our data suggest that habitat quality is more important than metal concentration for soil protection. Ecorestoration, rather than remediation, will likely be a more effective means of ameliorating zinc toxicity.

**TH134**

### Effects of atmospheric hydrogen chloride and ammonia on *Paronychiurus andrei* and *Oppia nitens* (Annelida) and *Folsomia candida* (Collembola)

J. Wey, J. Son, Korea University / Division of Environmental Science and Ecological Engineering; Y. Kim, Y. Lee, J. Hong, M. Lee, Korea University; K. Cho, Korea University / Division of Environmental Science and Ecological Engineering

As the use and distribution of various chemicals increase, there is a possibility of chemical accumulation in Korea, the incidence of chemical accidents is also increasing. Damage caused by chemical accidents is not only widespread but also has a long-term impact, making it difficult to predict damage and respond appropriately however, there are very few studies on chemicals that can cause accidents. Especially for chemicals exposed to gaseous state, little is known about the reactivity of soil biota such as *Collembola* and earthworm. The experiment was carried out in PS container filled with 30g of soil according to modified OECD 232 guidelines. Investigating the effects of gaseous hydrogen chloride and ammonia on *Paronychiurus kimi* (Collembola), the test vessels with *P. kimi* were exposed to two different concentration of toxic substances in the enclosed chamber for 20 minutes. After exposure, the test vessels with *P. kimi* were transferred to an incubator (20°, constant darkness) in a closed state, and the mortality and reproduction rate of *P. kimi* were observed after 1 hours, 2 weeks, and 4 weeks. There were no deaths after 1 hour, but the mortality rate was increased over time from 2 weeks. Also, after 4 weeks, the number of juveniles produced by adults *P. kimi* were decreased as concentration-dependent manner. These results show that the long-term effects of gaseous phase chemicals can occur at concentrations that are not acutely affected.

**TH135**

### Toxicity assessment of methyl ethyl ketone using earthworm and soil algae

R. Cui, Konkuk University / Department of Environmental Sciences; Y. An, Konkuk University / Department of Environmental Health Science

Methyl ethyl ketone (MEK) is a kind of ketone-based volatile organic compound and widely used as industrial solvent. There is a high possibility of leakage of this compound into soil environment, but few studies for ecotoxicity of MEK were present. This study evaluated the toxicity of MEK using earthworm *Eisenia andrei* and algae *Chlamydomonas reinhardtii* and *Chlorococcum infusionum*. *Eisenia andrei* were exposed with 1.0, 1.5, and 2 g of control or MEK soils with closed system. After 7 days exposed, mortality and abnormalities including posturing, fragments, swelling, bleeding, and mucous secretion were measured. For soil algae, *Chlamydomonas reinhardtii* and *Chlorococcum infusionum* were exposed with 2.5 g of control or MEK soils in 15 mL glass test tube, and chlorophyll intensity was measured after 6-day exposed. As results, 7d-LOEC and 7d-EC50 of MEK to *Eisenia andrei* were calculated as 1136 mg MEK/kg dry soil and 1910 (1643.00-2221.58) mg MEK/kg dry soil, respectively. For soil algae, *C. infusionum* was more sensitive than *C. reinhardtii* for MEK, 6d-EC50 to *C. reinhardtii* and *C. infusionum* were calculated as 3400.44 (3132.01-3690.94) mg MEK/kg dry soil and 60.97 (51.19-72.62) mg MEK/kg dry soil, respectively. These results can be used for risk assessment of MEK in soil ecosystem. *This work was supported by Korea Environment Industry & Technology Institute (KEITI) through "The Chemical Accident Prevention Technology Development Project" funded by Korea Ministry of Environment (MOE)(No. 201600197001). <strong>Key word: methyl ethyl ketone, earthworm, soil algae</strong>
Environmental Toxicology
We provide an overview of ecotoxicological effects of nitrogen-based energetic materials (EM) of notable ecological concern, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazoic (HMX), and 2,4,6,8,10-dihexanitro-2,4,6,8,10,12-hexaazaisowurtzitane (CL-20), bacterial strains at 200 mg/kg concentration. These results further confirm the Cu tolerance potential of these Eisenia andrei bacterial consortium decreased the ecotoxicity of metal inoculated substrates (200 mg/kg). Metallothionein (MT) was synthesized by bacterial consortia in copper containing media. These results revealed that the fraction of the biotic ligand and occupied by metal can be used to predict the metal toxicity, indicating the applicability of TBLM to explain metal toxicity to P. kimi in a simplified soil solution. Although the approach used in this study may be limited to soil solution, the use of TBLM can be a useful tool for investigating factors bioavailability and toxicity of metals.

THI41 Characteristics of metal-tolerant bacterial plasmids from a platinum mine tailings dam
T. Mahlazi, C. Bezuindenhout, M. Maboeta, North-West University / Unit for Environmental Sciences and Management
The presence of mine tailings is promoting the development of both heavy metal and antibiotics resistance among microbes with resistant plasmids. Plasmids provide their hosts with a large array of phytophototypes such as heavy metals and antibiotics resistance due to gene transfer. This study describes the characteristics of plasmids isolated from various bacteria that displayed an ability to withstand high metal concentrations. Isolated plasmids were individually transformed into Escherichia coli JM109. The plasmids were evaluated for metal tolerance capabilities using a microdilution approach where the plasmid DNA concentration ranged between 11.75-118.06 ng/μl after extraction. Incompatibility groups were determined by subjecting plasmids to PCR amplification using IncQ, IncP-9 and IncW specific primers, where only IncW provided positive results. Minimum inhibition concentrations (MICs) were carried out to determine the ability of transformed. E. coli JM109 to tolerate metals at varying concentrations. Results indicated that transformed E. coli JM109 developed ability to grow in the presence of several heavy metals. Some strains were resistant to high concentrations (+10 mM) of Ni(II)/Pb2+ and Ba2+ with metal resistance order of Ni(II)/Pb2+/Ba2+>Cu2+. Moreover, protein profiling was used to determine the impact of plasmids on E. coli JM109. Proteins were extracted from both transformed and un-transformed E. coli JM109 and subjected to one-dimensional (1D) and two-dimensional (2D) SDSPAGE. One dimension SDSPAGE illustrated general similarity of the profiles except for two bands in the two-dimensional bands where bands were present in the transformants which were resolved in the Al/Ni alloy containing media. Two-dimensional electron transfer PAGE analysis showed that some of the proteins were up-regulated while others were down-regulated. The largest numbers of proteins were from 15-75 kDa. Since the plasmids rendered the E. coli JM109 tolerant to metals, it can be concluded that the change in the protein profiles was due to the effects of the plasmids. Furthermore, that plasmids isolated from various heavy metal-tolerant bacterial species were successfully transformed into E. coli JM109 rendering new metal-tolerant strains which have been deemed resistant and are capable of using plasmids for metal tolerance. These plasmids characterized have advanced our understanding that these plasmids could be important reservoirs for resistant genes, and may hold significant biotechnology potential.

THI42 Sensitivity of the waterside species, Yuukianura szeptyckii (Collembola: Neanuridae), to cadmium and copper
Y. Lee, Korea University; J. Wee, J. Son, Korea University / Division of Environmental Science and Ecological Engineering; Y. Kim, Korea University; K. Cho, Korea University / Division of Environmental Science and Ecological Engineering
Collembola is the most abundant organism in the soil ecosystem and some species are used as ecotoxicological evaluation species for toxic substances in soil. However, Neanuridae species, which is one of the family of Collembola, are rarely studied as toxicity evaluation species. In this study, the toxicity sensitivity of copper and cadmium of Yuukianura szeptycki, known as the species in which they live water, were measured and their bioaccumulation amount were examined based on the ISO guideline 11267. After 28 days of exposure to tested metals, LC50 for adult survival and EC50 for reproduction were estimated. These toxicity values of Y. szeptycki were also compared to those of other collembolan species (F. candida and Parachyurus kimi) reported in literature to investigate their suitability as a new test species in toxicity test. Not only the adult survival but also the juvenile production of Y. szeptycki was measured in a concentration dependent manner after 28 days of exposure duration. Although the response of Y. szeptycki to the tested metals was not highly sensitive to the other collembolan species reported in literature, the study of the response of Y. szeptycki to chemicals in the soil is considered to be very important. Because their special habitat can provide an understanding of ecotoxicity against certain environmental conditions.

THI43 Drivers of copper and zinc availability and phytovailability in agricultural soils receiving long-term organic waste amendments
explained by their overwintering or ageing. In contrast to insecticides, tebuconazole (CYP) has a different mode of action in that its effect is not dose-dependent. The potential ecotoxicological effects of this contamination on soil organisms depend on Cu and Zn availability. The availability of Cu and Zn itself depends on their chemical speciation and consequently to the temporal evolution of soil parameters such as pH and organic carbon content and reactivity. These soil parameters are strongly influenced by the application of OW and the activity of soil organisms on the surrounding soil, i.e. the rhizosphere for plants. However, the ecotoxicological effects of OW applications and the combined effect are poorly documented when taken into account long-term impacts. Accordingly, we aimed at studying the relationship between the availability in soil and the phytoavailability of Cu and Zn in four decadal field trials that received different types of OW for more than ten years. Soils in the four field trials exhibited very different pH and organic carbon content. Copper and Zn availability was determined on 102 soil samples from the four field trials by (i) an equilibrium-based method using cupric ion selective electrode and the winemarker humic aqueous model (WHAM) to quantify Cu\(^{2+}\) and Zn\(^{2+}\) activities in soil solutions (pCu\(^{2+}\) and pZn\(^{2+}\)) and (ii) a kinetic method using the diffusive gradient in thin films (DGT) directly on soil samples. We measured key soil parameters in soil solutions to assess the relationship with pCu\(^{2+}\) and pZn\(^{2+}\). Copper and Zn phytoavailability is currently determined using the RHIZOtest which is a standardized test that will enable to measure the uptake flux of Cu and Zn in plants and the related availability of Cu and Zn in the rhizosphere that is physically separated from roots. The results already achieved showed no clear relationship between pCu\(^{2+}\) and pH or dissolved organic carbon among the four field trials altogether. When studying each trial separately, we observed a pH gradient as a function of the type of fertilizer (mineral or OW) applied prior to crop growth. To clearly discern the impact of OW applications, measurements will enable to test whether Cu and Zn availability in unplanted soils determined Cu and Zn phytoavailability or whether root-induced chemical changes in the rhizosphere additionally determined it.

**TH144**

**Toxic Effects of Cadmium on Chinese Cabbage, Folsomia Candida (collombola) and their Prediction Modes in 18 Soils of China**

L. Zheng, Y. Feng, Y. Zhou, Nanjing Institute of Environmental Sciences

In this paper, we adopted 18 Kinds of typical soils in China, and Chinese cabbage, *Folsomia candida* (collombola) were used as the research object. The germination and root elongation of cabbage seedling under different concentrations of cadmium in soil were measured. The endpoint of the *F. candida* was reproduction. The results show that the soil properties significantly affected the dose effect curve of cadmium, soil pH is the main influencing factor; at the same time, we calculated the toxic concentration and prediction models. This study has a guiding significance for the plant and invertebrates ecological risk prediction and assessment of heavy metal cadmium.

**TH145**

Do we plant protection products correctly? Impact of agrochemicals on non-target beetle, *Bembidion lampros* (Coleoptera: Carabidae)

J. MOKRAPATI, Institute of Environmental Sciences, Jagiellonian University / Ecosystems and Pest Control; G. S. Rohner, Soil & Crop Sciences Jagiellonian University; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation; R. Laskowski, Jagiellonian University / Ecotoxicology & Stress Ecology Group

Intensification of agriculture and the widespread use of pesticides during the last few decades has led to significant reduction of the abundance of non-target arthropods (NTA), including the ground beetles (Carabidae), which are natural pest enemies in agricultural areas. Due to the growing demand for food, it is not possible at the moment to stop using pesticides. We need, therefore, to make every effort to ensure that they are used in a way that do not jeopardize NTA. In the present study, three commonly used pesticide formulations: Durban 480 EC, containing the organophosphorus insecticide chlorpyriphos, tebuconazole, and epoxiconazole, and the pyrethroid cypermethrin (CYP), and Spekfree 430 SC, containing the fungicide tebuconazole (TEB), were tested for their effects on survival of the ground beetle *Bembidion lampros*. The beetles were collected from agricultural fields either in spring (after overwintering) or autumn (population dominated by newly emerged individuals) and exposed individually to a single pesticide spray applied with the Peritower. In terms of recommended field dose (RFD), Durban appeared almost 10 times more toxic than Sherpa: the 96-h LD₅₀ for Durban was 0.057 (CI 0.048-0.071) and 0.054 (CI 0.046-0.066) RFD for spring and autumn beetles respectively, and for Sherpa ~ 0.556 (CI 0.453-0.704) and 1.003 (CI 0.863-1.214) RFD respectively. However, the toxicity of both insecticides was almost identical in terms of their active ingredients (g a.i. ha⁻¹) – the LD₅₀ for CPF was 16.4 for spring and 15.6 for autumn beetles, and for CYP 16.7 and 30.1, respectively. The beetles survival rate decreased significantly with increasing dose of both insecticides, but the spring-collected beetles appeared more sensitive, plausibly explained by their overwintering or ageing. In contrast to insecticides, tebuconazol caused significant increase in survival at higher doses, possibly due to its interference with immune competence of insects or elimination of pathogenic fungi. The results show that at least some insecticide formulations may cause unacceptable effects on NTA when applied according to recommendations, indicating the urgent need for revising current pesticide usage recommendations. The differences in sensitivity between the spring and autumn-collected beetles call for further studies on whether such seasonal differences can be important for ERA. This study was supported by National Science Centre, Poland (2015/19/B/NZ6/01939)

**TH146**

The fate and bioavailability of currently used and emerging pesticides in agriculturally used fluvios - effects of soil and pest control measures

M. Šudoma, N. Neuwhitthová, Masaryk University; M. Svbodová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); L. Bielská, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; M. Hvezdova, Z. Simék, L. Skulcová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX

The class of conazole fungicides (CFs), among them epoxiconazole, tebuconazole, flusilazole and prochloraz are currently used pesticides and members of the triazole group, used as broad-spectrum fungicides that inhibit ergosterol biosynthesis and are typically applied as foliar sprays for cereals, sugar beet or oilseed rape. Conazole fungicides are widely used in EU countries and their residues are frequently found in European arable soils which corresponds to their environmental properties. CFs are strongly sorbed to soil (logKOC of 3–4) and have low to moderate water solubility (50–700 µg/L). They are very persistent in soils and tend to form long-term residues. Typical DT₅₀ values range from 120 days to 1 year. These attributes predetermine them to be highly bioaccumulative and hazardous. However, in real ecosystems, complex interactions occur (between pesticides, soil, microbes, earthworms, plants...) and these are poorly understood. Hence, in this contribution (poster), we would like to present the novel microcosm experiment, where the combined effects of soil properties, microorganisms, plants and earthworms on CF multimedia fate and bioavailability were evaluated. In particular, the CF fate (by means of total, desorbable and freely dissolved concentrations) and bioavailability (by means of uptake to model fauna, flora and passive samplers) is studied in complex microcosm systems consisting of agriculturally used fluvios under the addition of selected model compounds (RECETOX); K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln). These 10 soils are representative of a large fluvios range in terms of their qualitative and quantitative SOM properties (TOC, DOC, HA/FA, WHC, pH, texture, etc.).

**TH147**

A Field Trial to Determine Effects of Thiamethoxam treated Sugar Beet Seed on the Non-Target Arthropod Fauna of Arable Land in The Netherlands

C. Elston, Syngenta Ltd / Product Safety; M. Coulson, Exponent International Limited; F. Bakker, EurofinsMitox; F. Scherr, University / Research Centre for Toxic Compounds in the Environment (RECETOX); P. Thorbek, Syngenta / Environmental Safety; M. Finnergan, Syngenta

The aim of this study is to assess the potential effects of thiamethoxam, applied as a seed coating to sugar beet, on the full fauna of naturally occurring non-target arthropods (NTAs) in a commercial arable field in The Netherlands when compared to a non-insecticidal control treatment. This is a three year study which began in March 2017 with the drilling of the sugar beet seed at two different seed treatment rates equivalent to a typical sugar beet seed loading and oil seed rape seed loading using plots of 2 ha each organized in 4 blocks of 8 ha each (32 ha total study area). NTA field studies are important for investigating impacts of pesticides on populations, communities and different life stages of NTAs under realistic exposure conditions. Moreover such studies offer unique opportunities to assess the regulatory acceptable risk of a pesticide to NTAs in-field a study should be designed in a way that enables an adverse effect to be detected if present. A toxic reference is used to show the test design is adequate to demonstrate persistent adverse treatment-related effects. Many of the chemically historically used as toxic reference items with large historical datasets are now not available due to changing regulations, making it difficult to select a suitable toxic reference. Conducting such a study requires multiple sampling methods such as pitfall traps, mine traps, soil cores and sweep nets to account for different life histories of NTA species and a team of qualified taxonomists to identify all organisms. In this study NTA populations will be monitored for a three year period that covers at least two generations to enable the detection of any trans-generational effects that might occur. The current EU risk assessment scheme considers that effects on populations are acceptable for the in-field area above the threshold value of 50% if recovery or potential for recovery is demonstrated within 1 year. This study has been designed to enable the assessment of: (1) the magnitude of treatment effects on non-target
arthropod (NTA) populations, (2) the range of NTA taxa affected by the treatment and (3) the duration of treatment effects and the time period until populations recover. The evaluation will be based on (1) time to recovery (population density similar to control) and (2) persistence of effect (population growth similar to the control). Effects will be classified in accordance with De Jong et al. 2010.

THI48 Bioaccumulation kinetics of pesticides chlorpyrifos and tebuconazole in the earthworm Eisenia andrei in two different soils
M. Svobodová, Masaryk University RECETOX; K. Smidová, Masaryk University RECETOX / Research Centre for Toxic Compounds in the Environment (RECETOX); M. Hvezdová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); L. Biešklová, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX

This study was conducted to investigate the bioaccumulation of two pesticides currently used in large amounts in the agriculture, the insecticide chlorpyrifos and the fungicide tebuconazole. The two compounds have distinct properties suggesting their different fate in the soil and bioaccumulation. Their detailed uptake kinetics in the model earthworm species Eisenia andrei were measured to find a sufficient length of exposure to achieve equilibrium in concentration between soil and earthworm and to compare two pesticides in two arable soils differing in the organic carbon (1.02 and 1.93% respectively) and clay content (10.7 and 20.7% respectively).

Concentrations of the pesticides in soils and earthworms were determined at 59, 118 and 236 days after pesticide application to identify bioaccumulation in the soil and earthworm samples. According to our results, a steady state was reached after 

3 to 5 days for both pesticides and soils. The values of bioaccumulation factors calculated at the steady state ranged from 4.5–6.3 for chlorpyrifos and 2.2–13.1 for tebuconazole. Bioaccumulation factors were also calculated as the ratio of uptake and elimination constants with results comparable with steady-state bioaccumulation factors. The results suggested that the degradation and bioaccumulation of tested compounds by earthworms was influenced by more factors than only the organic carbon content in soils. The clay content also probably contributed, namely to degradation of chlorpyrifos by clay-catalysed hydrolysis and to decreased bioavailability of tebuconazole by binding to clay minerals. The lower Koc and hydrophobicity of tebuconazole relative to chlorpyrifos probably led to higher availability of tebuconazole through pore water exposure. On the other hand, higher hydrophobicity of chlorpyrifos probably caused an increase in availability by its additional uptake via ingestion.

THI49 Effects of diuron and imidacloprid on eight nematode species
J.N. Neury-Ormann, Iresta / EABX-CARMA; C.N. Doese, INRS - Centre Eau Terre Environnement; N. Majdi, Ecolab / UMR 5245 CNRS; J. Vedrenne, S. Morin, Iresta Bordeaux / UR EABX; S. Hôls, Ecosse / Animal Ecology; W. Traunspurger, Bielefeld University / Animal Ecology

To assess the pesticides diuron and imidacloprid (insecticide) on ubiquitous organisms at the basis of food webs, we performed multispecies toxicity tests using nematode species commonly found in soil and freshwater benthic ecosystems. Diuron and imidacloprid belong to the top 30 pesticides used in Europe. Diuron and imidacloprid are known to affect directly the reproduction of several nematode species, mainly by killing the adult nematodes and by inhibiting the reproduction of juveniles. The EC50 (1.02 and 1.93% respectively) and clay content (10.7 and 20.7% respectively), as examples. Soil ecotoxicity was estimated for the soil bioassay (BSAF) to provide an overview of the secondary poisoning to mammals and birds is a critical pathway for risk assessment of Pb in soil. This risk is generally assessed for the food-chain soil => earthworms => earthworm eating predators. Therefore, a correct evaluation of bioaccumulation of Pb in earthworms is essential for risk assessment of Pb in soils under the REACH Regulation and a literature review of biota-to-soil accumulation factors (BSAF) for Pb in earthworm species was made. To ensure that bio BSAF burdens are in equilibrium with soil Pb concentrations, only data from field studies or laboratory studies using soil and biota collected at the same field site were considered. Data from laboratory studies where Pb was added to the soil as a Pb salt were only used as supporting evidence. In total, 248 BSAF values for earthworms were identified that meet the reliability criteria, ranging from 0.01 to 22.05 (dry weight basis, median 0.23). Results are available for several earthworm species, belonging to different ecological groups of earthworms: anecic, endogeic and epigean earthworms. No distinct differences in BSAF values across these groups could be identified. BSAF values are derived in a wide range of soils and the data available can be considered as representative for earthworms in Europe. The cation exchange capacity (CEC) is significantly correlated with BSAF values. No significant correlation with Pb content, pH, organic carbon content or clay content is observed. The significant negative regression between log BSAF and log CEC was confirmed by laboratory studies and is also consistent with the significant decrease in Pb toxicity observed for Eisenia fetida reproduction with increasing CEC of the soil. It was concluded to implement the effect of soil properties on BSAF by using the overall regression between log CEC and log BSAF in the risk assessment of Pb in soil. This yields a generic BSAF of 0.30 on dry weight basis, corresponding to 0.0348 on a fresh weight basis, for the median eCEC value of 16 cmol/kg soil for European arable soils. BSAF values on fresh weight basis vary from 0.089 to 0.028 for soils with a CEC of 8 and 30 cmol/kg soil, respectively, corresponding to the 10th and 90th percentile of eCEC in European arable soils. Implementing effect of soil properties on BSAF improves consistency between assessment of secondary poisoning and direct toxicity of metals to soil organisms, where bioavailability corrections for varying soil properties are commonly accepted.

THI52 Hazard assessment of liquid organic hydrogen carriers in terrestrial environment
Y. Zhang, Dresden University of Technology / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry, M. Markiewicz, University of Bremen / Centre for Environmental Research and Sustainable Technology; S. Stolte, University of Bremen / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry

A proactive environmental hazard assessment of liquid organic hydrogen carriers (LOHCs) – a novel energy system which can efficiently and relatively safely store and transport hydrogen – was conducted by characterisation of potential behaviours and ecotoxicities of these chemicals in soil environment. Adsorption properties of promising LOHC candidates including indoles, quinaldines, carbazole derivatives, benzyldimethoxymethane and dibenzylidenepropane in terms of carbon-water partition coefficients (Koc) were investigated via HPLC screening. Further characterisation was performed via adsorption isotherm modeling and soil column leaching with the examination of soil-water partition coefficients and the calculation of the quinoline and 2-Mequinol (Quin-2Me) as examples. Soil ecotoxicity was estimated for the quinoline in the soil bacteria Arthrobacter globiformis and Collembola Folsomia candida in pore-water and soil exposure scenarios. The log Koc values generally increased following indoles < quinaldines < carbazole derivatives < benzyldimethoxymethane < dibenzylidenepropane. The mobility of LOHCs was thus classified as highly mobile, moderately mobile or immobile. Adsorption isotherm and column leaching showed the strongest adsorption and retention of the partially hydrogenated form (Quin-2Me-H2) in soils. The H2-rich form (Quin-2Me-H10) appeared the highest leaching capacity through the soil followed by the H2-lean form (Quin-2Me) implying the risk of groundwater contamination. Ionic-interaction was considered dominant in the adsorption of Quin-2Me-H10 to soils given its high protonation at the soil pH, while hydrophobicity was the main force in the adsorption of its two analogues. No or only slight toxicity was found for the quinolines in the Arthrobacter at the highest test concentrations (500 mg L-1 and 750 mg kg dry weight (dw) soil). Higher toxicity was found in the Collembola and malf 045

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of cuticle in the pore-water scenario were observed. Dose-response modeling showed 10 < LC₅₀ < 100 mg L⁻¹ (liquid-only exposure) and 100 < EC₅₀ < 1000 mg kg⁻¹ dw soil (calculated soil pore-water based) of the quinolines assigning these chemicals to category “harmful” to soil organisms. Predicted no-effect concentrations showed 1–3 orders of magnitude higher the effective concentrations than the former suggesting potential risks of the chemicals toward the soil environment and proper monitoring is needed in the application of the LOHCs. Key words: adsorption, bioavailability, hazard assessment

**TH153**

Combining field measurements and biotests to assess lead and zinc phytoavailability in contaminated urban soils

M. Bierlein, C. Chevassus-Rosset, CIRAD; L. Lemal, MetRHZlab; M. Montes, G. Moussard, E. Simon, M. Tella, CIRAD; M. Valimier, MetRHZlab; E. Doelsch, CIRAD / UPR Recyclage et risque; F. Feder, CIRAD; S. Legros, CIRAD / LITEN

Along with the French legislation on the recycling of wastes from wastewater treatment plants, a guideline was provided to stakeholders to prove the low mobility and phytoavailability of trace elements exceeding total concentration thresholds in soil. Due to the lack of adequate plant biotest at the time the guideline was published (i.e. in 2005), the guideline suggests to measure trace element phytoavailability in the aerial parts of plants collected in situ in contaminated and uncontaminated soils. The present study aimed at applying the guideline methodology with the combination of a recently developed plant biotest (i.e. the RHIZOtest) and field measurements to lead (Pb) and zinc (Zn) contaminated urban soils on which irrigation with treated wastewater was foreseen. Ten contaminated and uncontaminated soil samples (hereafter referred to as soil) were collected in representative sites expected to be irrigated with treated wastewater. The phytoavailability of Pb and Zn was estimated on each soil by measuring Pb and Zn concentration in the aerial parts of field-collected plants and by deploying the RHIZOtest and measuring the uptake flux of Pb and Zn in the whole plants exposed to the given soil. As expected field-collected plants exhibited a large range of Pb concentration in leaves, irrespective of total Pb and Zn concentrations and Pb and Zn mobility and phytoavailability measured in soils in the first step. In comparison, RHIZOtest measurements showed that only the contaminated soil 15 exhibited a significantly higher phytoavailability than other soils and have consequently be considered for irrigation with wastewater. This study thus showed how the use of a biotest dedicated to the measurement of trace element phytoavailability in combination with field measurements was useful to assess the risk of high phytoavailability in contaminated urban soils.

**TH154**

Can approaches beyond the traditional ones characterize the effects on soil microflora provide an added value in the scope of regulation?

K. Hund-Rinke, Fraunhofer IAME / Department of Ecotoxicology; A. Huenmller, Fraunhofer IAME; K. Schlich, Fraunhofer IAME - Institute for Molecular Biology and Applied Ecology; F. Wege, Fraunhofer IAME; G. Broll, University of Osnabrueck / Institute of Geography

Alongside the pollution regulation, side effects of chemical substances on the soil microflora focus on the determination of the nitrogen transformation (OECD 216). However, according to EASA a more comprehensive risk assessment is required. We investigated whether a combination of several test approaches addressing various microbial aspects results in a better understanding of the fluctuation of the soil microflora after a threat and a more comprehensive risk assessment taking the new requirements into account. We conducted experiments to assess the ecosystem services and the protection of the biodiversity into account. We used a silver nanomaterial as example and applied three functional approaches to get information on the functional microbial diversity: (i) potential ammonium oxidation activity (PAO) addressing a small, mainly autotrophic bacterial community with comparable low diversity; (ii) respiration activity of the heterotrophic microflora as indicator for the C-transformation with basal respiration activity and activity in the presence of carbon sources (glucose, cellubiose) as well as sulfur or nitrogen containing organic substances (cysteine, alanine); (iii) activity of selected exoenzymes (selection based on the carbon sources used in the second approach). The second and third approach were performed in microwell plates. The three functional approaches (i) PAO, (ii) C-transformation, (iii) exoenzymes seem to be a suitable assessment tool and can provide a benefit in the assessment of chemicals. The combination of results was dependent on the test concentration. The exoenzymes were the most sensitive indicator and seem to be a suitable early warning indicator. An increased concentration of the chemical responsible for the initial effect or a further impact can severely affect the microbial population. Additionally affected nitrifiers indicated a stronger damage. Effects in all three approaches indicated a severe impact. The high sensitivity of the exoenzymes in contrast to the respiration activity of the microbial cells could be due to their location outside the microbial cell and a lower protection level. However, also the small size of the ions as affecting substance has to be considered. In further experiments, the combination of results obtained with the three functional approaches have to be determined with additional chemicals. Due to the use of microwell plates the additional work load seems to be acceptable also for testing in the scope of regulation.

**TH155**

Re-calibration of the earthworm Tier 1 risk assessment of plant protection products - an update

G. Ernst, Bayer AG / Ecotoxicology; J. Bendall, Dow Agrosciences; T. Carro, FMC; H. Cunningham, Syngenta / Environmental Safety; A. Koutsafis, ADAMA; S. Loutseti, DuPont De Nemours Hellas S.A.; M. Marx, Bayer AG Crop Science Division / Environmental Safety - Ecotoxicology; B. O’Neill, DuPont Crop Protection; A. Shaples, FMG Agricultural Solutions; F. Staab, EFSA SE Thematic Group in tier 1 earthworm assessment; plant protection products (PPP) is expected to increase due to revision of the PEC₅₀ modeling guidance. The new EFSA guidance foresees to use worst case PEC₅₀ values for each European regulatory zone considering a lower soil bulk density, a lower organic carbon content, and a reduced crop interception rate due to consideration of worst case wash-off assumptions. Furthermore, several different soil layers for which PEC₅₀ values could be calculated are under discussion, i.e. 0-1 cm, 0-2.5 cm, 0-5 cm, and 0-20 cm soil depth. Calculated PEC₅₀ values based on the new EFSA guidance are estimated to strongly increase, which might lead to an overly conservative tier 1 risk assessment. In a project published by Christl et al. (2016), results from standard laboratory earthworm reproduction tests are compared with the effect levels in higher tier (field) earthworm studies on a representative set of European pesticides compiled by EPPO companies. In this exercise, the relevant soil layer for PEC₅₀ modeling and assessment factor were adjusted to result in tier 1 protection of unacceptable field study effects. The results of this evaluation give clear evidence that considering a layer of 0-5 cm in combination with the currently used assessment factor of 5 would lead to an appropriate earthworm tier 1 risk assessment (Christl et al. 2016). However, according to EFSA a more comprehensive risk assessment, including a correction of laboratory endpoints for lipophilic compounds (logP > 2), a correction of endpoints by a factor of 2 is proposed by EFSA (2015, EFSA Supporting publication 2015:EN-924) for studies containing artificial soil with 5% peat (formerly only endpoints from studies with 10% peat were corrected for high logP). Furthermore, in its Scientific Opinion, EFSA (2017) proposed Specific Protection goals for earthworms which include a maximum acceptable recovery time of 6 months for initial effects in field studies. This deviates from the current procedure of an acceptable recovery time of one year for earthworm populations. The dataset of 54 case studies was re-evaluated considering the new EFSA proposals and the new results will be presented.

**TH156**

Digging into the soil risk assessment of pesticides: current approach and its uncertainty

M. Arena, EFSA - European Food Safety Authority / Pesticides; D. Ateri, s. barmaz, EFSA - European Food Safety Authority / Pesticides Unit; S. Pieper, German Federal Environmental Agency (UBA) / Ecotoxicology; M. Rosset, CIRAD; E. Doelsch, CIRAD / Biotests Laboratory (RHIZOTEST); E. M. Moussard, E. Simon, M. Tella, CIRAD; M. Valmier, MetRHIZlab; E. Doelsch, CIRAD / UPR Recyclage et risque; F. Feder, CIRAD; S. Legros, CIRAD / LITEN

Along with the French legislation on the recycling of wastes from wastewater treatment plants, a guideline was provided to stakeholders to prove the low mobility and phytoavailability of trace elements exceeding total concentration thresholds in soil. The present study aimed at applying the guideline methodology with the combination of a recently developed plant biotest (i.e. the RHIZOtest) and field measurements to lead (Pb) and zinc (Zn) contaminated urban soils. As expected field-collected plants exhibited a large range of Pb concentration in leaves, irrespective of total Pb and Zn concentrations and Pb and Zn mobility and phytoavailability measured in soils in the first step. In comparison, RHIZOtest measurements showed that only the contaminated soil 15 exhibited a significantly higher phytoavailability than other soils and have consequently be considered for irrigation with wastewater. This study thus showed how the use of a biotest dedicated to the measurement of trace element phytoavailability in combination with field measurements was useful to assess the risk of high phytoavailability in contaminated urban soils.

**TH157**

SETAC Soils Interest Group

M.H. Wagelmans, Bioclear earth Risk Assessment and Soil Restoration

Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (P)
TH158
A novel analytical method for simultaneous quantification of Bracken fern produced carcinogenic ptaquiloside-like compounds and their derivatives V. Kissielius, Metropolitan University College; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences; M. Rodamer, Agilent Technologies; D. Lindqvist, L.H. Rasmussen, Metropolitan University College

Significant variety of toxic secondary metabolites produced by plants appear in chemical structures of glycosidic molecules. These compounds are highly water soluble and mobile in soils and sediments. In cases when toxic glycosides are persistent and released in high loads from vegetation, evaluation of the risk to aqueous environments adjacent to drinking water supplies is needed. Nevertheless, the determination of pteridium alkaloids and fate of pteridium alkaloids are largely unknown. This study aims to identify the environmental risk factors that predetermine release of glycosidic natural toxins from non-agricultural lands to aqueous ecosystems. Bracken ferns (Pteridium aquilinum) are known to produce up to 6 kg/ha of carcinogen ptaquiloside. Previous studies demonstrate leaching of ptaquiloside from Bracken to soils and upper ground waters. The ptaquiloside-like compounds – pterosineloa and pterosine – have recently been studied in Australian Brackens. Except from a few positive samples included in the Australian study, there have been no reports of these compounds in Europe. We hereby report a novel method for quantification of ptaquiloside, caudosatine and ptesculentoside and their respective pterosin-derivatives (6 compounds in total) to be used for the aforementioned study. The novel LC/MS method (Agilent 1260 Infinity HPLC System; Agilent 6130 S) is based on HPLC conditions with a max. pressure of 400 bar. Mobile phase with a low fraction of acetonitrile is applied (10% v/v). These factors are favorable for high-throughput analysis and could be practically utilized in, e.g. water supply facilities. The method will be applied for studies of the spatial and temporal variation of the 6 compounds in in plants, soils and surface waters. The project is part of the European Training Network NaToxAq, investigating the natural toxins in waters from the perspectives of their physio-chemical properties, spatial and temporal variation, health risks and concepts of water treatment operations for their removal (Horizon 2020 Research and Innovation Programme - Marie Skłodowska-Curie, grant agreement No. 722493).

TH159
A novel method for ptaquiloside and pterosin B preservation in groundwater samples

N. Skrbić, University of Copenhagen / Plant and Environmental Sciences; S.C. Christensen, A. Pedersen, HOFOR A/S; Copenhagen; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences; L.H. Rasmussen, Metropolitan University College

Analyzing natural toxins in groundwater is challenging due to their labile and chemical properties, including salting out and desorption/ionization, their structural variation, and concepts of water treatment operations for their removal (Horizon 2020 Research and Innovation Programme - Marie Skłodowska-Curie, grant agreement No. 722493).

TH160
Harmful algal bloom smart device application: using image analysis and machine learning techniques for classification of harmful algal blooms.


Newport University College and the U.S. EPA Office of Research Development in Cincinnati Agency are collaborating to develop a harmful algal bloom detection algorithm that estimates the presence of cyanobacteria in freshwater systems by image analysis. Green and blue-green algae exhibit different Hue-Saturation-Value color histograms in digital photographs. These differences are exploited by machine learning techniques to train a smart device (cellular phone, tablet, or similar) to detect the presence of cyanobacteria in a small surface portion of a freshwater system. The Harmful Algal Bloom Classification Application (HAB APP) has been field tested and verified to classify both green and blue-green algae. Specifically, the APP has been tested on several small streams and ponds, correctly classifying green algae blooms and has been tested on the Ohio River, correctly classifying blue-green algae in the 636-mile cyanobacteria bloom in summer 2015. The application is being tested via fixed camera monitoring stations and optimized at several locations along the Ohio River and in Lake Harsha, a 22,000-acre reservoir which supplies six million gallons per day of drinking water to the Ohio county in which it lies and is a source of many recreational activities, including swimming, boating, and fishing. The presence will be verified by other detection instruments and in vitro by agency scientists and hysteresis techniques will be used to detect water (presumably) regularly (e.g. daily, seasonally) basis at the monitoring stations. Further, the APP is being extended to classify harmful algae microscopically at the genus level using a convolutional neural network approach.

TH161
Matrix-assisted laser desorption/ionization-time of flight mass spectrometry application for rapid screening of microcystins occurrence in northern Taiwan tap-water reservoirs

W. Ding, National Central University / Department of Chemistry

Microcystins (MCs) are the most common hepatotoxins and tumour promoters produced by freshwater cyanobacteria. Due to the damaging liver through inhibition of protein phosphatases 1 and 2A, they pose a serious health threat to humans and animals, and even inducing death. MC-LR and MC-YR are probably the most concern and toxic microcystics. They are also widely distributed and detected in the freshwater system worldwide. In this study, matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF-MS) technique was developed for the rapid screening of these toxins in tap-water reservoirs in northern Taiwan. In addition, solid phase extraction (SPE) was used for sample cleaning-up and target analytes enrichment. The extracted target toxins were separated on a C18 column with washing of 10% methanolic solution, and then eluting with methanol. The limit of quantitation of MC-LR and MC-YR was 0.06 μg/L, which was below the limits recommended by WHO guidelines for drinking water (presence). A preliminary result revealed that C18 was a good choice for target MC-LR and MC-YR were detected in two reservoirs water samples by using the developed method.

TH162
Smelly HABs: response-surface optimized HS-SPME/GC/MS method for monitoring multi-class HAB odor compounds in water

C. Avagianos, M. Pisasia, T. Kaloudis, EYDAP SA / WATER QUALITY CONTROL

HABs are known to produce a wide range of malodorous compounds belonging to various chemical classes such as terpenes, ions, amines, halides, ketones and sulfurous compounds. Such compounds have detrimental effects to the aesthetic quality of water, making drinking water unpalatable by consumers and damaging recreational and tourism enterprises in lakes. Although HAB odorous compounds are generally non-toxic to humans at environmentally relevant concentrations and they do not inevitably indicate the co-occurrence of cyanotoxins, there is a need for water utilities and water authorities to apply effective methods for monitoring for early-warning and control of off-odor events. The objective of this study was to develop and optimize an efficient method for monitoring of multi-class HAB odors in freshwaters using automated HS-SPME/GC−MS. The study focused on optimization of the SPME factors, including salting-out effect, pre-incubation and extraction times, extraction temperature and stirring rate. 20 model compounds of various chemical classes were investigated as indicators of the wide range of odor compounds, ranging from volatile, early-eluting (e.g. alkyl sulfides) to late-eluting compounds (e.g. ionones). Factor effects on the responses (extracted ion peak areas) were assessed. Design of experiments (DoE) techniques included preliminary Plackett-Burman factorial designs for screening of significant factors, followed by a 4-factor Box-Behnken design to assess linear and quadratic main effects and factor interactions and to optimize responses. Optimization was based on the minimization of the objective for maximum sensitivity screening of the whole range or of certain classes/groups of compounds. Optimization experiments resulted in full-quadratic response models for individual compounds, while desirability functions can be
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TH163
Suspected screening of cyanotoxins in freshwater by high performance liquid chromatography coupled to high-resolution mass spectrometry
D. Filitova, IDAEA- CSIC / IDAEA; m. picardo, IDAEA CSIC Barcelona / IDAEA; O. Núñez, Universitat de Barcelona / Department of Chemical Engineering and Analytical Chemistry; M. Faire, IDAEA-CSIC / Environmental Chemistry

Cyanobacteria are one of the components of the water microcosmos in freshwater ecosystems. The community distribution is affected by water quality, flow regime, climate, and geology. During the past decades, there has been a noticeable increase of cyanobacterial blooms, dominating in many freshwater bodies worldwide. Some cyanobacteria species are known to produce toxic secondary metabolites called cyanotoxins, which vary in structure and harmful properties (hepatotoxins, neurotoxins), and being a major concern for drinking water supply and recreational water use. The most widespread cyanotoxins are microcystins (MCs) variants MC-LR, -RR, -YR, with MC-LR being the most toxic one. For this reasons, the World Health Organization appointed a guideline of 1 μg/L in drinking water for total MC-LR. In order to monitor levels of cyanotoxins and prevent both human poisoning and wildlife damage, suitable analytical methods need to be developed. This work presents the development of a sensitive, fast and reliable method for analysis of MCs and CYA using high-performance liquid chromatography coupled to high-resolution mass spectrometry (HPLC- HRMS). For the sample treatment of cyanotoxins, solid-phase extraction for multiple toxins has been employed, which was recently developed in our research group. The chromatographic separation was achieved using a C18 analytical column (150x2.1 mm, 5μm) using methanol and water as mobile phase. The total chromatographic run was 15 min. The chromatographic separation was coupled to a Q-Exactive Orbitrap instrument (Thermo Fisher Scientific). The interphase used was ESI under positive conditions. The main advantage of high-resolution mass spectrometry will be the target analysis of 10 cyanotoxins, as well as the analysis in scan mass spectrometry to assess the potential presence of transformation products and other non-targeted toxins in the samples. This multi-toxin method has been developed and validated for freshwater cyanobacteria such as microcystis, nodularin, cylindrospermopsin, and anatoxin-a. The developed method was applied for the study and characterization of cyanotoxins concentrations in Catalonia freshwater reservoirs. Keywords: cyanotoxins, microcystins, high-resolution mass spectometry.

TH164
Oligonucleotide probes for fluorescence in-situ identification of cyanobacterial cells in surface waters
I. dejana, Water Research Institute National Research Council / National Water Research Institute; A. Barra Caraciolo, National Research Council / Water Research Institute; P. Gennini, National Research Council of Italy (CNR) / Water Research Institute; c. fajardo, Facualdo de Veterinaria, Complutense University Avenida Puerta de Hierro s/n, 28040 Madrid, Spain; M. Martin-Fernandez, UCM / Biochemistry and Molecular Biology; l. medlin, Marine Biological Association of the UK, The Citadel, Plymouth PL1 2PB, UK; G. Mengs, Natural Biotec SL; m. sacca, Council for Agricultural Research and Economics (CREA), Agriculture and Environment Research Center (AA), Via di Corticella 133, 40128 Bologna, Italy; m. lettieri, European Commission, DG Joint Research Centre, Directorate D Sustainable Resource Use of Water and Marine Resources TP 121, Via E.Fermi, 2749, 21027 Ipra (VA), Italy Harmful cyanobacterial blooms have been increasing in freshwater ecosystems in recent decades, mainly because of eutrophication and climate change. In some cases, some cyanobacterial species can produce toxins and this phenomenon can have a negative impact and pose a risk for ecosystem and human health. Of the 15 known cyanobacteria genera, more than 40 species produce toxins, which are natural compounds showing different chemical and toxicological characteristics. Cyanobacterial toxins are responsible for both acute and chronic poisoning in animals and humans. Among the main classes of cyanobacteria, microcystis are among the most frequently found in the environment. These toxins are accumulated mainly in the liver, but also in the intestines and kidneys and can be very dangerous for both animal and human health (Luchetti and Ortonni, 2011). Fast and sensitive methods to identify unequivocally Microcystis aeruginosa and Planktothrix agardhii are very useful to discriminate these species with respect to the other non-toxic cyanobacteria. For this purpose, we designed, developed and validated some oligonucleotide probes (GNPlankS02, PlAqD03, MicAerD03) for FISH (Fluorescence In-Situ Hybridization) analysis to detect these species in freshwater samples. The FISH probes were designed using the ARB software with the Silva database in the framework of the MicrCoKit project. We tested different fixative methods to minimise the natural autofluorescence from chlorophyll-a (Groben and Medlin, 2005) to visualize Microcystis aeruginosa and Planktothrix agardhii under a laser confocal microscope. Firstly, the FISH probes described have been tested on pure cultures of M. aeruginosa and P. agardhii species, then the probes were successfully applied to natural samples collected from surface waters. Keywords: Microcystis aeruginosa; Planktothrix agardhii; FISH probes; algal bloom

TH165
Adquacy of EPI Suite prediction models to estimate physicochemical properties of natural toxins potentially present in surface water
L Rodrigue Led, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES, M. MacLeod, ITM - Stockholm University / Department of Environmental Science and Analytical Chemistry
Natural toxins constitute a potential risk to water supplies in Europe. Only a few risk assessment frameworks require sensitive (e.g., EPI) and estimates of their degradation rate constants in the aquatic environment that have been determined by experimental methods or estimated using quantitative structure-activity relationship (QSAR) and quantitative structure-property relationship (QSPR) models. QSAR predictions should be considered carefully when applied to a set of chemicals that are structurally distinct from those that were used to develop the model. The establishment of an applicability domain of the models provides a range of chemicals where the predictions are expected to be reliable and based on interpolation rather than extrapolation, regarding the structure of the chemicals in the training set (Gramatica 2007). We present here an analysis of the applicability domain of selected EPI Suite™ QSAR models, and interpret the results with reference to natural toxins within these limits that could be included in a systematic prioritization of natural toxins in water according to their persistence and mobility. References Bucheli, Thomas D. 2014. “Phytoxins: Environmental Micropollutants of Concern?” Environmental Science & Technology 48 (22):13027–33. Gramatica, Paola. 2007. “Principles of QSAR Models Validation: Internal and External.” QSAR & Combiantorional Science 26 (5):694–701. US EPA. 2017. Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11. United States Environmental Protection Agency, Washington, DC, USA.

TH166
Cyanobacterial oligopeptides of environmental concern and (co)production dynamics
R. Sanchis Natumi, E. Vorony, Erawg Swiss federal Institute of Aquatic Science and Technology / Department for Environmental Chemistry, E. M. Janes, Erawg Swiss federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry Our ecosystems and drinking water resources are not only vulnerable towards anthropogenic pollutants. Natural toxins present an additional threat for which we still lack comprehensive knowledge. It is important to understand the broad spectrum of natural toxins from various kingdoms, those produced by aquatic organisms have a direct entry into our water resources. More frequent and intense surface water blooms of cyanobacteria have triggered particular scientific interest in their secondary metabolites as potential aquatic toxins. The variety of cyanopeptides is well documented since the 1990s and the growing publication record reflects an increasing scientific awareness of these biologically active compounds, which have been found in cyanobacteria species characterized by indicative monomeric building blocks. Microcystins are by far the most intensively studied class of cyanopeptides. While it is known that many cyanopeptides are produced simultaneously from one species, the co-production of these potential toxins has not been explored comprehensively for cyanopeptides beyond microcystins. This project focused specifically on the production and co-production dynamics of cyanopeptides under different culturing condition of common cyanobacterial strains. Our targeted LC-HRMS analysis of biomass samples of single strain cultures show that besides microcystins, cyclamides and various cyanopeptolins are co-produced. Our data shows the evolution of the
peptide abundance throughout the growth phase of single strains (e.g., Microcystis aeruginosa and Anabaena flos-aquae) and under different culturing conditions (e.g., N:P ratios and light intensities) by multifactorial analysis. New insights into co-production dynamics offer critical information about cyanotoxins mixtures present during harmful algal blooms and with that critical knowledge towards comprehensive risk assessment.

TH167 Degradation of the carcinogenic ptaquiloside under alkaline conditions
D. Lindeqvist, L. Rasmussen, Metropolitan University College
The carcinogenic ptaquiloside (PTA) is found in several species of ferns worldwide. The distribution and occurrence is well described for genus Pteridium (Bracken fern). However, only a few species limit the PTAs occurrence to the fern. PTA is suspected of causing Human gastric cancer. PTA is a non-sesquiterpene glycoside and is not sorbed by soils to a great extent (logKOW of approx. -0.5). Hence, PTA can leach from Bracken stands. Leaching is most prominent during rain but baseline levels are found in streams in Bracken infested areas. Soil contamination and contamination of upper aquifers has been observed on a number of occasions. PTA may contaminate groundwater resources. Dissipation of PTA under environmental conditions is governed by a number of factors: Enzymatic activity; pH (hydrolysis); irreversible sorption/reactions; and sorption to clay minerals. Bacterial activity and hydrolysis are the most important mechanisms causing dissipation of PTA. The purpose of this study was to describe the underlying mechanisms for the hydrolysis of PTA and formation of reaction products under near-sterile alkaline conditions as found in calcareous aquifers. PTA (4,700ppb) was deglycosidated using 0.10%10.1.0 M NaOH and 3 different 0.02SM buffer systems (approx. pH 7-12; NaHPO/NaH2PO4; pH regulated with 0.1M NaOH). Dissipation of PTA and formation of reaction products were monitored up to 200hrs at 25°C. PTA and the main reaction product pterosin B (PTB) was quantified by LC-MS using SIM- and TIC-modes. Formation of other reaction products was analysed simultaneously using the relative area distribution of the main reaction mass. Chemical rate constants are reported for degradation of PTA and species formation. Dissipation of PTA were pH dependent as previously observed. Addition of 0.01-1.0M NaOH results in immediate degradation of PTA and formation of a small amount of PTB plus two more reaction products. The concentration of PTB remained constant over time. PTB is the endproduct of hydrolysis in pure solutions. One reaction products was identified as the bracken dienone (BDE), a ultimate carcinogenic. BDE is formed immediately while the unknown is formed from BDE reaching stoichiometric balance within the timeframe of the experiments. Rate of formation were dependent on pH, as well as of the buffer system used. The results indicate that PTA under alkaline conditions will form carcinogenic reaction products that are stable in groundwater.

TH168 Experimental Determination of Octanol-Water Partitioning Coefficients of Natural Toxins
C.D. Schoenece, Agroscope / Environmental Analytics; K. McNeill, ETH Zurich / Institute of Chemical and Environmental Analysis; T. Bucheli, Agroscope ART / Environmental Analytics
The octanol-water partitioning coefficient (Kow) remains one of the key parameters in environmental fate and risk assessment of organic chemicals for regulatory purposes.[1] Based on predicted Kow values, many natural toxins are expected to be mobile in the aquatic environment. If such toxins are not retained well in soils, they may move up through the water reservoirs and thus enter the aquatic environment, with physicochemical and structural complexity due to large number of various functional groups, current estimation models for Kow, and other phase distribution coefficients show limited applicability.[2] Thus, experimentally determined physicochemical property data are still of great value to regulatory organizations defining thresholds for potential environmental contaminants. In this study, Kow values were experimentally evaluated by both indirect and direct approaches based on well-established OECD methods modified for application in natural toxic analysis. A multi-step molecular size and functional group specific calibration procedure is applied in indirect evaluation of natural toxin partition properties based on chromatographic retention. Direct analysis of partitioning behavior is performed in a miniaturized shake flask system in standard HPLC vials. As HPLC based methods, both approaches show the capability to largely automated for more efficient, less error-prone analysis and thus allow the reliable determination of Kow in the for potential aquatic contaminants relevant range of log Kow from -2 to 5. Natural toxins for analysis comprise previously investigated mycotoxins and isoflavonoids as reference compounds in addition to representatives of natural toxins found in aquatic organisms. In regards to predicted toxicity, persistence and mobility as well as plant occurrence, specific alkaloid subclasses such as pyrrolizidine alkaloids from Senecio spp. or quinolizidine alkaloids from Lupinus spp. are investigated in more detail. As an indicator for the partitioning of natural toxins from aqueous media to organic matrices, Kow can be seen as first proxy estimating natural toxin mobility in the aquatic environment. Thus, experimental data will help in prioritizing of toxins for further research activities, including field studies and lab-based characterization of fate processes e.g., within the current MC-ITN NaToxAqu [1] ECECTOC; Technical Report No. 123, 2013.[2] Schenzel, et al.; Environ Sci Technol 2012.

TH169 Phytotoxins as aquatic micropollutants: a procedure for prioritization
B.F. Guenthardt, Agroscope / Environmental Analytics; J. Hollender, Eawag / Environmental Chemistry; M. Scheringer, ETH Zurich / Institute for Chemical and Bioengineering; K. Hungerbuehler, ETH Zurich / Institute for Chemical and Bioengineering; T. Bucheli, Agroscope ART / Environmental Analytics
Phytotoxins are natural toxins produced by plants with widely varying molecular structures and toxic effects. Despite possibly high concentrations of natural toxins in vegetation, crops and freshwater, they are not yet commonly perceived as environmental contaminants of possible concern. This far, environmental exposure and effect studies have only been conducted for a very limited number of mycotoxins, and systematic and larger monitoring campaigns are completely lacking. A crucial challenge is to systematically identify among the plethora of phytotoxins those that actually present a serious risk for the aquatic environment. For this purpose, we ranked 1586 phytotoxins from over 800 plant species compiled in a previously developed database based on three critical properties: toxicity, plant frequency and environmental behavior of the phytotoxins. Toxicity was included as descriptor of the effect and parameterized by both plant, and estimated compound toxicity. Plant frequency, obtained from InfoFlora, was used to estimate the occurrence of all plant species producing a certain secondary metabolite class and serves as an approximation of exposure. To identify the phytotoxins relevant for the aquatic environment we used a procedure, which systematically ranks substances suspected of causing human gastric cancer. Pterosin B is formed from ptaquiloside upon hydrolysis. Similar pterosins are formed from caudatoside and ptesculentoside. The rate of hydrolysis is strongly dependent on pH and temperature. Under environmental conditions - pH5-7 - pterosin B will form as one of the main products of hydrolysis. At lower or higher pH other compounds may form from ptaquiloside. Pterosin B is not toxic, but is interesting as the compound can be used to assess previous presence of ptaquiloside. Studies have shown rapid microbial degradation of pterosin B in upper soil layers, but longer lifetime is expected in sediments with low microbial activity such as aquifers. The purpose of this study is to assess the sorption of pterosin B and to estimate Kd and Koc. Sorption of pterosin B was studied following OECD Guideline 106 and 9 different Danish soils (SOC -0.1<7.4, pH 3.3-7.7). 0.25g of dry soil was equilibrated with 9ml 0.01M CaCl over-night. 1ml of pterosin B solution in 0.01M CaCl was added resulting in a Caq of 0-10 mg L (n=20). Sorption was studied after a contact time of 24hrs. The aqueous phase were separated by centrifugation and the content of pterosin B quantified by LC-MS-ESI SIM (100µL injections; range 0.0-100 µg L; r² = 0.999). Caq were calculated as COaq = Caq - COaq. Irrespective sorption and microbial degradation was considered based on previous studies. Pterosin B sorption strongly to the soils tested. This was expected due to the aromaticity of pterosin B and the logKOW of 3.3. Kd ranged between 70 and 180 mL g⁻¹ for the soils tested corresponding to a Koc values of 300-2,500 mL g⁻¹. The study demonstrates that pterosin B sorp strongly to soil materials, especially to soil organic material. As Koc values can vary substantially, depending on soil type and properties like mineral content, sorption behavior can vary expected in the results. Provided low microbial activity, pterosin B will most likely stay in aquifers and can indicate previous presence of ptaquiloside.

TH170 Sorption of pterosin B to soil materials
J. Andersen, L. Rasmussen, Metropolitan University College
Bracken ferns (Pteridium sp.) are considered environmentally problematic due to their content of the carcinogens ptaquiloside, caudatoside and ptesculentoside (‘the ptaquiloside group’). Brackens are classified by WHO/IARC in Group 2B due their carcinogenic properties at cellular level and due to their association with several veterinary diseases. Brackens cause bovine urinary bladder cancers and are suspected of causing Human gastric cancer. Pterosin B is formed from ptaquiloside upon hydrolysis. Similar pterosins are formed from caudatoside and ptesculentoside. The rate of hydrolysis is strongly dependent on pH and temperature. Under environmental conditions - pH5-7 - pterosin B will form as one of the main products of hydrolysis. At lower or higher pH other compounds may form from ptaquiloside. Pterosin B is not toxic, but is interesting as the compound can be used to assess previous presence of ptaquiloside. Studies have shown rapid microbial degradation of pterosin B in upper soil layers, but longer lifetime is expected in sediments with low microbial activity such as aquifers. The purpose of this study is to assess the sorption of pterosin B and to estimate Kd and Koc. Sorption of pterosin B was studied following OECD Guideline 106 and 9 different Danish soils (SOC -0.1<7.4, pH 3.3-7.7). 0.25g of dry soil was equilibrated with 9ml 0.01M CaCl over-night. 1ml of pterosin B solution in 0.01M CaCl was added resulting in a Caq of 0-10 mg L (n=20). Sorption was studied after a contact time of 24hrs. The aqueous phase were separated by centrifugation and the content of pterosin B quantified by LC-MS-ESI SIM (100µL injections; range 0.0-100 µg L; r² = 0.999). Caq were calculated as COaq = Caq - COaq. Irrespective sorption and microbial degradation was considered based on previous studies. Pterosin B sorption strongly to the soils tested. This was expected due to the aromaticity of pterosin B and the logKOW of 3.3. Kd ranged between 70 and 180 mL g⁻¹ for the soils tested corresponding to a Koc values of 300-2,500 mL g⁻¹. The study demonstrates that pterosin B sorp strongly to soil materials, especially to soil organic material. As Koc values can vary substantially, depending on soil type and properties like mineral content, sorption behavior can vary expected in the results. Provided low microbial activity, pterosin B will most likely stay in aquifers and can indicate previous presence of ptaquiloside.

TH171 Modelling the fate of natural toxins in the soil using DAISY- a case study of ptaquiloside
D.B. Garcia Jorgensen, University of Copenhagen / Plant and Environmental Sciences; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences; M. Styczen, E. Diamantopoulos, P. Abrahamson,
University of Copenhagen
Natural toxins are gaining more interest in the scientific community as emerging pollutants. The reason behind is that they are released continuously to the environment and often in high amounts. The related risks to humans depend strongly on the physicochemical characteristics, load and fate of the natural toxins in the environment. The aim of this work is to develop a modelling approach to predict these fate and in particular the leaching of natural toxins in the vadose (soil) zone. For this reason, we used the model code DAISY, a soil–water–plant model code, which has been used. Modelling of natural toxin fate presents several challenges compared with xenobiotics: many and partly continuous sources, variable and poorly studied physicochemical properties of the toxins, highly variable temporal and spatial rates of transfer of the toxins from the source plant to soils, - often linked to climate events. This work focused on ptaquiloside (PTA), a hydrophilic and non-sorbing toxin that exhibits a strongly pH and temperature dependent degradation. The carcinogenic toxin is produced by bracken fern (Pteridium aquilinum) that usually forms dense stands. The PTA content in bracken is up to 9800 µg g⁻¹ dry matter. The modelling approach was to parameterize a bracken growth submodule in order to simulate biomass and canopy. Spraying was used as the method to apply the toxin to the canopy, similarly to pesticides as included in DAISY. It is assumed that the toxin is washed off from the canopy with precipitation. The model was improved with new parameters to characterize hydrolysis. Hydrolysis is pH and soil horizon dependent, while microbial degradation rates follow the guidelines by FOCUS. The maximum PTA concentration in the leachate at a depth of 2 m were 2.5 and 1 µg l⁻¹ in a sandy loam and sandy soil, respectively. These could indicate that the bracken is essential to the elucidation of original concentrations. Clayey soils presented higher leaching due to macropore transport, as toxins might bypass the biologically active soil layers. Leaching accounts for less than 1% of the total PTA load, being highest in autumn when bracken wilts and the amount of water percolating is highest. The model presents several uncertainties such as the toxin production in the biomass, seasonal variations in toxin concentrations and in particular, the transfer rates from plant to soil. Spraying is not an ideal "dosing" function and might overestimate the leaching, hence the results must be taken with caution.

**TH172**
**Genotoxic insight into biosynthetic pathway of retinoids by cyanobacteria**
L. Sehnal, Masaryk University, Faculty of Science, RECETOX; K. Hilscherova, Masaryk University, Faculty of Science, RECETOX; K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX

Extensive occurrence of cyanobacterial water blooms associated with the production of wide range of toxic compounds into environment represents one of the most important problems in aquatic ecosystems. One group of the recently discovered cyanobacterial toxic compounds are endocrine disruption compounds retinoids. It has been documented that cyanobacteria are potent producers of retinoids and they are able to produce these compounds into their surrounding environment. However, our understanding how are retinoids synthesized by cyanobacteria on genomic level remains poor and description of the biosynthetic machinery is scarce. It is publicly available genomes of cyanobacteria that made it possible to decipher the evolutionary genomics of original significance of these molecules for cyanobacteria. In the animal kingdom, biosynthetic apparatus for retinoids synthesis has already been described. Mayor role in their synthesis from carotenoids play the enzymes aldehyde dehydrogenases (ALDH) and cytochromes (CYP). Our study has been inspired by biosynthetic apparatus of retinoids in animals and provides an evolutionary comparison of all ALDH and CYP genes from publicly available genomes of cyanobacteria. We identified all characterized ALDH and CYP from human and mouse, which are involved in the biosynthesis of retinoids. This comprehensive phylogenetic study describes evolutionary similarity of bacterial ALDH to human and mouse ALDH from family 1. This fact points out to a similar function of these enzymes in the biosynthetic machinery of retinoids. Based on these results, the most related cyanobacterial ALDHs (to human) were selected from different cyanobacterial genomes and heterologously expressed in direct cloning proficient E. coli strain GB05-dir. Effectiveness of expression reflected as the amount of produced retinoids was assessed by in vitro bioassay on cell line P19/A15 with endogenous expression of retinoid receptors stably transfected with reporter luciferase gene under the control of retinoid responsive elements in mammalian cells. One group of the recently discovered all-trans retinoic acid was measured by LC-MS/MS. The project is supported by the Czech Science Foundation and National Sustainability Program of the Czech Ministry of Education, Youth and Sports (LO1214 and LM2015051).

**TH173**
**Emerging treatment methods for the removal of cyanotoxins from drinking water with focus on Advanced Oxidation Processes**
M. Schneider, Masaryk University, Faculty of Science, RECETOX; L. Blaha, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment RECETOX

Cyanobacteria form blooms in freshwaters due to environmental pollution and can produce taste and odour compounds, but also substances that have been shown to be toxic to animals, humans and other organisms. Numerous events of cyanotoxin-associated poisonings of pets, livestock, birds, wildlife and humans, and in some cases even subsequent death, occurred – and still occur – globally. These mainly waterborne secondary metabolites can adversely affect the quality of water intended for drinking and recreational purposes. So far, most countries have not yet enforced strict regulations regarding maximum tolerable cyanotoxin levels in drinking water. Some countries adapted the WHO provisional guideline value of 1 µg/L for microcystin-LR or amended it for country-specific regulatory values. Due to their diversity, fluctuating environmental occurrence and concentration, conventional drinking water treatment can result in insufficient removal of cyanotoxins. Advanced Oxidation Processes (AOPs) are emerging treatment methods that have been shown to be very promising for the removal of organic pollutants in general, also providing a potential for the removal of cyanotoxins. AOPs promote the in situ formation of highly reactive radicals, mainly hydroxyl radicals, and other mechanisms. Hydroxyl radicals are non-selective and randomly attacking oxidants, usually reacting with very short reaction constants in order to produce carbonyl compounds. In this study we investigated the potential of AOPs for cyanotoxin removal from drinking water by comparing the performance of thermal, photolytic, and catalytic AOPs in a laboratory scale system for the treatment of drinking water with focus on Advanced Oxidation Processes.
B1 (AFB1) and total aflatoxin (AFT), as a screening test, was used in order to analyze imported nuts, from non-European countries, intended for direct human consumption. The percentage of AFS positive samples (only pistachios and almonds), taken during the three years from 2013 to 2015, under the national programs of official control, amounted to 9% for B1 and 10.5% for AFT, and were confirmed by HPLC (High Performance Liquid Chromatography). The results demonstrated that this approach from Turkey to Italy, as well as that ELISA is a sensitive screening method to monitoring residue levels. The aflatoxin levels in pistachios exceeded even more than five times the maximum permitted limits set by European Commission in Reg 165/2010 and referred to the edible part of the tree nuts. The higher incidence of AFS in imported shelled pistachios is probably due mostly to an easier aflatoxin contamination following the fact that pistachios packed with intact cuticles are more resistant to the A. flavus colonization. The paper should be of interest both for readers in the areas of hazard analysis for monitoring purpose, and for other researchers in mycotoxin field, due to the great utility of low-cost, rapid and reliable methods of analysis

TH176
Impact of climate change drivers on toxin contamination and genotoxicity in Mytilus galloprovincialis: combined effects of warming, acidification and harmful algal blooms.
A.R. Braga, Biology Department CESAM, Aveiro University; C. Camacho, IPMA, IP.; V. Pereira, R. Marcal, A.M. Marques, Biology Department CESAM, Aveiro University; S. Guirrme, Biology Department CESAM, Aveiro University / Biocat, Universidade de Vigo; M. Pacheco, Biology Department CESAM, Aveiro University / Dept of Biology; P. Costa, IPMA, IP.

Mytilus galloprovincialis under current environmental conditions and at conditions simulating scenarios of climate change, namely warming, acidification and the combination of these two factors were exposed to paralytic shellfish poisoning (PSP), toxins-producing dinoflagellate G. catenatum. Shellfish toxicity derived from the accumulation of algae toxins was assessed in mussels at the four treatments as well as the damage at DNA level via the comet assay. Mussels were acclimated for 21 days and then exposed to G. catenatum, during 5 days (uptake), followed by 10 days with non-toxic diet (elimination). The analyses of PSP toxins in the mussels were carried out by Liquid chromatography with Fluorescence detection (HRMS and HILIC-MS/MS). Both techniques highlighted the presence of high PST contamination levels, with samples collected in 2016 containing up to 10851 µg STX eq/kg. Unexpectedly, together with PST, tetrodotoxin was detected in Sicilian mussels. Although this was the first report of STX in Italy, contamination levels found in mussels (0.8-6.4 µg/kg) were well below the regulatory limit of 2 µg. STX eq/kg established for STX in Japan. Interestingly, much higher contamination levels of STX (413 µg/kg) have been detected in mussels collected in 2017 in the NE Adriatic coasts of Italy (Lagoon of Marano), in the frame of the monitoring program for marine biotoxins regulated in the EU. [1] Wu Z, Xie L, Xia G, Zhang J, Nie Y, Hu J, Wang S, Zhang R 2005. A new tetrodotoxin-producing actinoymete, Norcardiopsis dassonvillei, isolated from the east China sea, can produce TTX. Toxicon 45:851-859. [2] Yasumura T, Yotsu M, Michishita T, Endo A, Kotak Y 1986. Bacterial production of tetrodotoxin and anhydrotetrodotoxin. Agric. Biol. Chem. 50:793–795. [3] Kodama M, Sato S, Sakamoto S, Ogata T 1996. Occurrence of tetrodotoxin in Alexandrium tamarense, a causative dinoflagellate of paralytic shellfish poisoning. Toxicon. 34:1101-1105.

TH177
Interest of bivalves for the biosurvey of cyanotoxins in aquatic ecosystems
E. Lance, University Reims Champagne Ardenne / Biology and Biochemistry; A. Lepoutre, UM2 INERIS-UCA-ULH SEBIO; Z. Amzil, IFREMER / Laboratory Phycology; E. Pomer, UMR CNRS Ecobio / UMR Ecobio; L. brient, University of Rennes 1 / UMB 6553 ECOBIO

The eutrophication of aquatic ecosystems, associated to climate change, enhance the frequency and the severity of cyanobacterial proliferations. Cyanobacteria are photosynthetic organisms producing endotoxins such as neotoxins, hepatotoxins, dermatotoxins, and cytoxins, threatening target organisms and humans. The recent delineations of cyanotoxins microalgae effects on organisms is overall quite well documented. However, the neotoxin β-methylamino-L-alanine (BMAA), suspected to be a causative agent in the human neurodegenerative disease amyotrophic lateral sclerosis (SLA), is less studied. The bioaccumulation of BMAA has recently been demonstrated with high selective analytical methods in various marine organisms (zooplankton, mussels, oyster, fish), but rarely in freshwater organisms. Bivalves are known to consume phytoplanktonic species such as cyanobacteria or diatoms, both known to produce BMAA, and can be used as sentinel organisms to reveal the environmental contamination. A dual approach, in the laboratory and in situ, is used to evaluate the pertinence of the bivalves Anodonta anodonta, Dreissena polymorpha and Mytilus edulis as bioindicators of the contamination of fresh and estuarine waters by MCs and BMAA. The laboratory approach consist in the evaluation of the kinetics of BMAA and MCs accumulation and detoxification in bivalves at various times and concentrations of exposure. The in situ approach consist in the evaluation of the MCs and BMAA accumulation in caged bivalves along a river continuum from with running freshwater to brackish waters, in coastal areas used for mussel aquacultures. First results show MC and BMAA accumulation in laboratory-exposed D. polymorpha and A. anodonta, with varying kinetics. Freshwater and marine bivalves also accumulated MCs in situ and a MC transfer from fresh to estuarine waters occurred, highlighted by an accumulation in the marine bivalve M. edulis. The results of this project will facilitate the long-term tracking of the contamination of ecosystems by cyanotoxins, which will provide an advance in the knowledge about the ecodynamics of cyanotoxins and the mainst conditions of human exposure.

TH178
Tetrodotoxin: an Emerging Threat to Humans in the Mediterranean Area: First Detection in Italian Mussels
C. Dell'Aversano, University of Napoli Federico II, Department of Pharmacy / Pharmacy; L. Tartaglione, University of Napoli Federico II / Department of Pharmacy; A. Penna, University of Urbino / Department of Biomedical Sciences; M. Giacobbe, Institute for Coastal Marine Environment, CNR; S. Pigozzi, M. Milardi, Fondazione Centro Ricerche Marine; P. Bordin, L. Bigi, Istituto Zooprofilattico delle Venezie; A. Turner, Plymouth University / Food Safety

Tetrodotoxin (TTX) is one of the most potent neurotoxins, originally found in ovary and liver of pufferfish (Tetrododontidae) [1]. Successively, TTX was isolated from other marine and terrestrial animals, as xanthid crab, trumpet shellfish, blue-ringed octopus, gastropods, starfish, and frogs. The wide distribution of TTX in genetically unrelated organisms has made TTX origin for long time controversial, with different kind of bacteria being identified as TTX-producing organisms [2]. Even Alexandrium tamarense – one of the paralytic shellfish poisoning toxins (PST) producing organisms – was proposed as potential biogenetic source of TTX [3]. Although fatal human poisonings following consumption of TTX-contaminated seafood have been reported so far only in Japan, the accumulation of TTX in fish, oysters and mussels collected in Europe (Spain, Portugal, UK, Greece) has been recently reported. So, in the frame of a collaborative study on evaluation of PST-related risk in the Mediterranean area, mussels collected in the Siracuse bay (Sicily, Italy) over a three year period (2015-2017), were analyzed by hydrophobic interaction liquid chromatography coupled with both high resolution and tandem mass spectrometry detection (HILIC-HRMS and HILIC-MS/MS). Both techniques highlighted the presence of high PST contamination levels, with samples collected in 2016 containing up to 10851 µg STX eq/kg. Unexpectedly, together with PST, tetrodotoxin was detected in Sicilian mussels. Although this was the first report of TTX in Italy, contamination levels found in mussels (0.8-6.4 µg/kg) were well below the regulatory limit of 2 µg. TTX eq/kg established for TTX in Japan. Interestingly, much higher contamination levels of TTX (413 µg/kg) have been detected in mussels collected in 2017 in the NE Adriatic coasts of Italy (Lagoon of Marano), in the frame of the monitoring program for marine biotoxins regulated in the EU. [1] Wu Z, Xie L, Xie G, Zhang J, Nie Y, Hu J, Wang S, Zhang R 2005. A new tetrodotoxin-producing actinoymete, Norcardiopsis dassonvillei, isolated from the east China sea, can produce TTX. Toxicon 45:851-859. [2] Yasumura T, Yotsu M, Michishita T, Endo A, Kotak Y 1986. Bacterial production of tetrodotoxin and anhydrotetrodotoxin. Agric. Biol. Chem. 50:793–795. [3] Kodama M, Sato S, Sakamoto S, Ogata T 1996. Occurrence of tetrodotoxin in Alexandrium tamarense, a causative dinoflagellate of paralytic shellfish poisoning. Toxicon. 34:1101-1105.
-RR, -YR, -LF, -LW, -LA, -LY, -WR; nodularin; cylindropermopsin and anatoxin-a) as well as other bioactive metabolites of cyanobacteria (isomers of lipopeptide puwainaphycin F). The quality of the anatoxin-a analysis was assured by the use of D5-phenylalanine internal standard. Cylindropermopsin (CYN) has been confirmed (4.25 microgram/g d.w.) in a single bloom from the pond Pisecky (South Moravian region close to Slovakian and Austrian borders) detected by invasive species Cylindropermopsis raciborskii. The other species found in CYN-positive bloom were C. Cylindrus, Aphanizomenon flos-aquae. Cylindropermopsin aphanizomeneoids (formerly known as Aphanabaena aphanizomeneoids), Pseuodoanaibaena limnetica and Planktothrya limnnetica. For the first time we have identified anatoxin-a in total 3 samples from the Czech Republic (concentration ranging 0.34 - 3.82 microgram/g d.w.), all originated from South Bohemen region around Prague. The selected pretreatment/clean up methods and the selected sampling years 2013 and 2015. The species of Dolichospermum sp. were found in all three anatoxin-a positive samples (different species in different samples - D. planctonica, D. smithii and D. flos-aquae). The phytoplankton communities of the anatoxin-a positive blooms were fairly rich in composition containing also Aphanocapsa sp., Aphanizomenon sp., Microcystis sp., Woronichinia sp., Sphaeroresporis sp. In addition to CYN and anatoxin-a, the paper discusses concentrations of other above mentioned cyanotoxins and bioactive metabolites and their risks.

**TH180**

**Toxic cyanobacteria succession during a drier season in a water reservoir in Sicily, Southern Italy. Implications for monitoring programs and risk assessment.**


Sicily, in the middle of the Mediterranean Sea, is the largest Italian island and is characterized by a dry hot climate. During the fourties-sixties of the last century several water reservoirs have been built for drinking and irrigation water, and some of them have been interested by harmful cyanobacteria blooms. However, monitoring programs have been discontinuous, and no recent data are available for most of them. Therefore, a quarterly two years survey of main lakes used for drinking and irrigation water supply started in 2016, with a complete (chemical, physical, microbiological and microscopic) analysis of samples, according to the Italian D.Lgs 158/2006, completed by a water toxicity assessment through a Vibrio fischeri ecotoxicological test (ISO 11348-3:2007), Lake Disuerei (37°11’26’’N 14°17’16’’E) was the only one in which a persistent bloom occurred during 2017 summer. After the July sampling when a Microcystis sp. bloom was first detected, the frequency of sampling was increased, to assess the risk of the exposed population and wild and domestic animals. Between mid-Jul and mid-Sept the composition of the cyanobacterial community changed dramatically. In July the bloom was dominated by Microcystis sp. and Cylindropermopsis raciborskii (in the order of 109 and 108 cell/L, respectively), the only two species detected. By mid-Aug these two species disappeared and have been substituted by Anabaenopsis sp. and Plankthotrix rubescens, which in mid-Sept were still growing (109 and 108 cell/L, respectively). Disuerei Lake is among the largest lakes, with a surface of 1,856 km2 and a maximum depth of 31 and 15.2 m, due to landfill and increasing and persistent dryness, depth can be reduced as much as to 1 m. Cyanobacteria are not always present (from Nov 2016 until Jul 2017 no species has been detected) and sediments represent probably the source for the inocula triggering the blooms, as well as a sink-source for nutrients, in the agricultural area of the water catchment. Results on chemical (nutrients and cyanotoxins) and molecular analysis will be discussed with a risk-based approach, to determine the risk for health for the population and to plan future management strategies.

**TH181**

**Cyanobacteria taste and odor compounds; a study in freshwaters of Greece**

C. Christophoridis, EYDAP SA / WATER QUALITY CONTROL; T. M. Triantis, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; I. Argyropoulos, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; T. Kaloudis, EYDAP SA / WATER QUALITY CONTROL; T. M. Triantis, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; A. Hiskia, NCSR Demokritos / Institute of Nanoscience and Nanotechnology

Invasive alien species represent a worldwide threat to the integrity of native communities, which increase the introduction rate of species and exacerbate global changes in slow present concerns as chemical pollutants do, and are thus often referred to as biological pollution. The red seaweed Asparagopsis armata exudes on the fatty acid profile of two marine invertebrates

C.O. Silva, Polytechnic Institute of Leiria; T.F. Simeos, S.C. Novais, Polytechnic Institute of Leiria / MARE IPE/Leiria; M.F. Lemos, Institute Politécnico de Leiria / MARE IPE/Leiria

Invasive alien species represent a worldwide threat to the integrity of native communities, which increase the introduction rate of species and exacerbate global changes in slow present concerns as chemical pollutants do, and are thus often referred to as biological pollution. The red seaweed Asparagopsis armata exudes on the fatty acid profile of two marine invertebrates

TH182

**Determination of multi-class cyanotoxins in fish tissue**

C. Christophoridis, National Center for Scientific Research / Institute of Nanoscience and Nanotechnology; I. Argyropoulos, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; T. Kaloudis, EYDAP SA / WATER QUALITY CONTROL; T. M. Triantis, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; A. Hiskia, National Center for Scientific Research / Institute of Nanoscience and Nanotechnology

The analysis of cyanotoxins in aquatic organisms, particularly in fish, has lately received increasing interest, due to environmental concerns and public health issues. This study presents the development and optimization of novel, sensitive and accurate analytical methods for the simultaneous determination of multi-class cyanotoxins i.e Cylindrospermopsin (CYN), Anatoxin-a (ANA-a) and Microcystins (MCs), in freshwater fish tissues. For the efficient extraction of selected cyanotoxins from fish tissue (muscle and liver), prior to LC-MS/MS analysis, several combinations of extraction solvents at different pH were tested. Additionally, various treatment techniques, i.e. protein precipitation using addition of salts and hexane extraction of lipids, were also tested in order to eliminate matrix effects and to maximize the recovery of the target compounds. Different SPE materials were evaluated for the maximum preconcentration of the compounds and in order to further eliminate matrix interferences. The effect of matrix components was evaluated by comparing LC-DAD and LC-MS/MS chromatograms under identical chromatographic conditions. Finally two extraction/clean-up methods were developed, i.e. one for the maximum recovery of selected MCs and one for CYN and ANA-a, offering maximum recoveries for the selected toxins. The developed methods were applied on fish samples, collected from Greek Lakes. The optimized method for MCs provided maximum recoveries 87% and 81%, for MC-RR and MC-LR, respectively. These compounds did not co-elute with several matrix components after the selected pretreatment/clean-up method, therefore matrix effect was minimal. CYN and ANA-a co-eluted with several matrix components, which induced detection limits due to low sensitivity and affected method trueness. The use of the optimized methods, including several clean-up steps, significantly improved the recoveries, reaching 58% for ANA-a. Nevertheless, the use of isotopically-labeled surrogate standards, especially for CYN, would significantly improve the efficiency of the method. The diversity and accumulation of toxins in fish collected by Greek lakes, is presented in relation to the risks associated to human consumption. Acknowledgements: The authors would like to sincerely acknowledge COST Action ES1105 “CYANOCOST” and the program of Industrial Scholarships of Stavros Niarchos Foundation for the Culture and Humanities.
especially FAs have great structural diversity and high biological specificity, essential for every living cell, as sources of energy, as membrane constituents, or as metabolic and signaling mediators. FAs have long been used as food-web tracers, and, more recently, changes in FA profile have also been exploited to better understand how contaminants affect organisms in aquatic foodwebs (Silva et al. 2017). In this study, the potential impact of A. armata exudates in the FA profile of two marine invertebrates was assessed. For that, after calculating the lethal concentrations of the algae exudate, *Gibbula umbilicalis* and *Palaeon serratus* were exposed for 168 hours to non-lethal concentrations of this exudate. Consequently, the trends in changes of FA abundance and composition were evaluated separately in the body tissue of the snails and in the shrimps hepatopancreas. Results showed different FA profiles between invertebrates but for both species the profile was influenced by exudate concentration exposure, with significant alterations being observed for several saturated FA and polyunsaturated FA like Acid Arachidonic (ARA), EPA or DHA. These alterations can represent an impact on these organisms’ cell function since some of these FA have important communication and signaling roles within and between cells. Fatty acid profile showed to be a sensitive and highly informative parameter to address effects of marine exudates toxicity in cohabiting invertebrates, thus constituting a promising tool for understanding biological pollution effect assessment in these coastal organisms.

**TH185**  
**Impacts of Asparagopsis armata on marine invertebrates: behavioral and biochemical responses**  
C.O. Silva, Polytechnic Institute of Leiria; C.E. Silva, S.C. Novais, Polytechnic Institute of Leiria / MARE IPILeiria; M.F. Lenos, Instituto Politécnico de Leiria / MARE IPILeiria

The introduction of non-native seaweeds outside their native distribution range, through human activities, has been causing documented negative effect on native species. The red algae *Asparagopsis armata*, with its invasive strategy including specialized cells capable of producing compounds with potent biological effects, is capable of inducing significant changes in terms of native community composition. This is specially occurring in rocky pools (intertidal zone) where *A. armata* releases several compounds that in these enclosed and extreme conditions are often adverse for other organisms such as other seaweed, vertebrates, and invertebrates leading to severe consequences for coastal ecosystems. The main objective of this study was to evaluate the potential impact of *A. armata* on marine invertebrates by exposing the common prawn *Palaemon serratus* and the marine snail *Gibbula umbilicalis* to the exudate of this macroalgae. The seaweed collected at the coast of Peniche, (Portugal) was left in laboratory tanks, for 12 hours, in the dark at 20ºC±1.

Algae exudates were collected from two species of the macroalgae: *Asparagopsis armata* and the marine snail *Gibbula umbilicalis* to the exudate of this macroalgae. The seaweed collected at the coast of Peniche, (Portugal) was left in laboratory tanks, for 12 hours, in the dark at 20ºC±1.

After assessing the lethal concentrations of the algae exudate, animals were exposed for 168 hours to non-lethal concentrations of this exudate and subsequently analyzed for biochemical biomarkers responses associated with detoxification (glutathione-S-transferase, GST), antioxidant defenses (catalase, CAT; superoxide dismutase, SOD), oxidative damage (lipid peroxidation, LPO; DNA damage), neurotoxicity (acetylcholinesterase, AChE) and energy metabolism (lactate dehydrogenase, LDH; Isocitrate dehydrogenase, IDH; electron transport system activity, ETS; content in lipids, proteins and carbohydrates). Also, behavioral endpoints were performed using the flipping behavior for *G. umbilicalis* and the avoidance behavior for *P. serratus*. The biomarker responses analysed on invertebrates showed an impairment of their physiological status after exposure to this algae exudate, with both species suffering from disruptions in their neural and energy metabolism functions, as well as from oxidative stress inducing damage in their macromolecules. Behavioural responses were also highly sensitive to *Asparagopsis* exudate exposure. These results represent an important step in the research of toxic exudates released to the environment and can serve as warning indicators of exudate exposure. These results represent an important step in the research of toxic exudates released to the environment and can serve as warning indicators of exudate exposure. These results represent an important step in the research of toxic exudates released to the environment and can serve as warning indicators of exudate exposure. These results represent an important step in the research of toxic exudates released to the environment and can serve as warning indicators of exudate exposure.

**TH186**  
**Cyanobacterial toxins - a threat to the human respiratory tract?**  
B. Kabíčková, Masaryk University, Faculty of Science; P. Laboha, Masaryk University / Research Centre for Toxic Compounds in the Environment RECETOX; J. Hildebrandt, Universität Greifswald / Animal Physiology and Biochemistry; K. Hilscherova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; P. Babica, Masaryk University Faculty of Science / Research Centre for Toxic Compounds in the Environment RECETOX

Intensified occurrence of toxic cyanobacterial blooms is becoming a major human health threat. Microcystin-LR (MCLR) is probably the most frequent and abundant cyanotoxin detected in the environment, known to induce primarily hepatotoxic effects. Nevertheless, MCLR has also been recognized to induce adverse respiratory conditions. Although protein adducts with the molecular weight corresponding to MCLR were detected, MCLR did not alter the PP2A complex were tested for the oyster. The urinary Cd concentration in female had potential 80% higher for ocean acidification scenario than that for non-ocean acidification. However, results revealed that exceedance risks of renal dysfunction and osteoporosis for gender-specific consumption only and whole groups under 2100 ocean acidification were no significant difference with that of current non-ocean acidification scenario. This study concluded that ocean acidification was not likely to increase synergistically the renal dysfunction and osteoporosis of human health risk through shellfish consumption.

**TH187**  
**Effects of microcystin-LR and cyanobacterial LPS in human airway in vitro models**  
O. Brůzman, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; B. Kabíčková, P. Babica, Masaryk University Faculty of Science / Research Centre for Toxic Compounds in the Environment RECETOX; P. Babica, Masaryk University Faculty of Science / Research Centre for Toxic Compounds in the Environment RECETOX

Cyanobacterial lipopolysaccharides (LPS) represent another bioactive component of cyanobacterial biomass, which is likely to expose human beings simultaneously with MCLR, thus we studied also effects of LPS isolated from a culture of cyanobacterium *Microcystis aeruginosa* PCC7808. Dose- and time-dependent formation of MCLR-protein adducts was observed in the exposed human bronchial cells. Several genes from OATP family previously implicated in the cell uptake of MCLR were found to be expressed in HBE1 and/or 16HBE140- cells. Nevertheless, MCLR (up to 20 μM and 48 h) did not induce significant cytotoxic effects. MCLR targets protein phosphatases (PP1/PP2A), which are the major regulators of MAPKs ERK and p38. Although protein adducts with the molecular weight corresponding to MCLR-PP2A complex were detected, MCLR did not alter phosphorylation of MAPKs ERK1/2 and p38 in bronchial cell lines. Short
exposures to LPS (10 μg/mL) also did not significantly decrease cell viability and neither MCLR nor LPS affected gap junctional intercellular communication in bronchial cell lines. Regardless MCLR cell uptake, the toxin was relatively less cytotoxic to human bronchial epithelial cells when compared to the effects of other cyanotoxins (e.g. cylindrospermopsin), or in comparison with other cell types (e.g. hepatic or neural cells). Further experiments should focus on more detailed characterization of MCLR uptake and on long term effects of MCLR and LPS on inflammation-related endpoints. Inhalation toxicity of other hazardous cyanobacterial blooms components and their complex mixtures, such as extracts and LPS isolated from different cyanobacterial strains and natural water blooms, should be also investigated in the future. The research was supported by the Czech Science Foundation Grant No. GJ17-25279Y and H2020-MSCA-ITN-2016 Project No.722493 NToxAq.

TH188
Estrogene and retinoid-like activity in stagnant waters
M. Smutná, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; T. Prochazková, Research Centre for Toxic Compounds in the Environment, Faculty of Science, Masaryk University / Research centre for toxic compounds in the environment; J. Priebojová, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment RECETOX; E. Sychrová, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; Z. Sehnal, Masaryk University Faculty of Science RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; K. Hilscherová, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX

Cyanobacterial water blooms represent worldwide problem in many freshwater as well as marine ecosystems as producer of substantial amount of various bioactive compounds, some of which can cause adverse effects and pose risk to both aquatic organisms and human. Recent investigations indicate that cyanobacterial metabolites could include compounds with estrogenic and/or retinoid-like activity. Endocrine disruptive compounds can cause disturbance in hormone signalling and adverse effects in biota even at very low concentrations. Retinoids play a role as important signalling molecules which control vital cell processes like morphogenesis, development, reproduction or apoptosis. This study focused on freshwater ponds and reservoirs affected by water blooms and determined the estrogenic and retinoid-like activity of water by in vitro bioassay as well as concentrations of main estrogenic and retinoid compounds by LC-MS/MS analyses. Water samples from freshwater reservoirs and ponds with water blooms elicted estrogenic activity up to 2 ngEQ/L. This activity could be only partly explained by the concentration of estrogenic hormones, alkenylphenols or phytooestrogens. Other compounds might play a role in these effects as well. Maximal detected retinoid-like activity in water samples reached 256 ng EQ/L. We analysed the presence of nine retinoid substances, where 4-keto all trans retinoic acid and retinal were the most common forms detected in the samples. Retinoid-like activity was almost fully explained based on concentration and relative contribution of retinoids. However, our results also suggest that still other compounds with retinoidic receptor-mediated modes of action are present. Our study highlights the ability of common species of cyanobacteria to produce retinoids naturally and excrete them directly into the environment in concentrations that can reach hazardous level for vertebrates in aquatic environment such as fish or amphibians. The SOLUTIONS Project is supported by the Seventh Framework Programme (FP7-ENV-2013) of the European Union under grant agreement no. 603437.

TH189
Excitatory effects of 2,4 -diaminobutyric acid on leech Retzius nerve cell membrane potential
S. Spanel, Faculty of Medicine, University of Belgrade / Institute for Pathophysiology; M. Stanojević, V. Nedičkov, Faculty of Medicine, University of Belgrade / Institute for Pathophysiology Ljubodrag Buba Mihailović; M. Prostran, Faculty of Medicine, University of Belgrade / Institute for Pharmacology, Clinical Pharmacology and Toxicology; S. Lopićić, Faculty of Medicine, University of Belgrade / Institute for Pharmacology Ljubodrag Buba Mihailović; M. Smuč, Nanjing Institute of Environmental Sciences, MEP

Neurotoxicity of 2,4 -diaminobutyric acid (DABA), a non-protein amino acid, was first shown after isolation from Lathyryus and related seeds, but mechanisms of neurotoxicity were never completely explained. DABA is also produced by Cyanobacteria in aquatic and terrestrial ecosystems. In the light of scarcity of electrophysiological studies and ubiquitous presence of DABA-producing Cyanobacteria, we induced excitotoxic effects in isolated cell potential of Retzius leech nerve experiments. Experiments were conducted on Retzius nerve cells of isolated segmental ganglia of the leech H. sanguisugus. Classical intracellular recording technique was performed. Cell membrane potentials were recorded using glass single-barrel microelectrodes and amplified with a high input impedance amplifier. DABA was administered in concentrations of 1, 3, 5 and 10 mM over a period of three minutes each. Input membrane resistance was investigated using clamp current technique by injecting hyperpolarizing current pulses through the recording electrode via a Wheatstone bridge unit. Application of 1mM DABA solution depolarized membrane potential by 5.0 ±0.43 mV (n=6, p<0.01), while 3 mM DABA produced depolarization of 9.8±4.18 mV (n=7, p<0.01). Rapid and substantial depolarization of membrane potential by 39.6±2.22 mV (n=9, p<0.01) was induced by 5 mM DABA, and administration of 10 mM DABA caused membrane depolarization of 47.0±5.43 mV (n=6, p<0.01). DABA had several times higher efficacy than Glutamate and β-N-methylamino-L-alanine (BMAA) on our model. After washout, cells exposed to 1 or 3 mM DABA fully recovered, but on the cells treated with 5 mM DABA and washed recovery. Application of 10 mM DABA induced a decrease of the input membrane resistance by 8.0±1.51 MΩ (n=7, p<0.01). DABA elicits substantial dose-dependent membrane depolarization. Decrease of input membrane resistance indicates that this effect is a consequence of increased membrane permeability. At higher concentrations DABA induces irreversible functional changes of neurons, confirming neurotoxic effect. As DABA is often produced together with BMAA and other cyanotoxins, some of their previously attributed neurotoxicity could possibly be due to effects of DABA and/or their synergy. Keywords: 2,4-diaminobutyric acid, Cyanobacteria, Retzius nerve cells, neurotoxicity

TH190
Generating ectotoxicity information on microcystins and prymnesins: A different approach

There is a lack of information for estimating safe levels for aquatic life concerning the toxicity of natural toxins produced by cyanobacteria and algae. The current literature indicates that LC50s for microcystis chronic results will only half of the toxicological effect. As DABA produced an increased membrane permeability. At higher concentrations DABA induces irreversible functional changes of neurons, confirming neurotoxic effect. As DABA is often produced together with BMAA and other cyanotoxins, some of their previously attributed neurotoxicity could possibly be due to effects of DABA and/or their synergy. Keywords: 2,4-diaminobutyric acid, Cyanobacteria, Retzius nerve cells, neurotoxicity

TH191
Proteomic analysis of rice plant exposed to long-term microcystin-LR exposure
Jiang-Naning Institute of Environmental Sciences, MEP

Irrigation with cyanobacterium-blooming water containing microcystins (MCs) poses potential threat to the growth of agricultural plants. Rice (Oryza sativa L.) is an important grain crop and is widely grown for domestic consumption in China. However, large amounts of rice field in the middle part of China has been irrigating with cyanobacterial-blooming water. So far, the molecular mechanism of MCs induced inhibition and growth sublethal and genotoxic effects in rice plants remains unclear. In the present study, rice plants were exposed to 1.0 μg/L and 50 μg/L of microcystin-LR (MC-LR) in the hydroponic nutrient solution for 34 days. The proteomic profiles of rice leaves after exposure were analysed using tandem-mass-tag labelling and LC-MS/MS analysis. The results showed that a total of 298 differentially expressed proteins were found, 89 differentially expressed proteins of them in 1.0 μg/L MC-LR treatment group, and 289 differentially expressed proteins in 50.0 μg/L MC-LR treatment group. Different response characteristics of protein expression were found in rice leaves exposed to low-concentration (1.0 μg/L) and high concentration (50.0 μg/L) of MC-LR,
respectively, and the different biological pathways involved in the mechanism of MC-LR-induced toxicity to rice were revealed using GO Term and KEGG analysis. Exposure to 1.0 µg/L and 50 µg/L of MC-LR could disturb the photosynthetic and ribosome pathways in rice leaves, causing the adverse effects on the normal growth and photosynthesis of rice. The significant alterations of the biological processes induced by the exposure to 50 µg/L of MC-LR were the inhibition of ribosome, porphyrin and chlorophyll metabolism, photosynthesis, and terpenoid backbone biosynthesis-related pathways, and the induction of thioredoxin, inositol phosphate metabolism, vitamin B6 metabolism and flavonoid biosynthesis related pathways in rice leaves. These results provide evidence of the molecular mechanisms underlying adverse effects in terrestrial plants exposed to water containing microcystins (MCs).

**Keywords:** rice, microcystin-LR, photosynthesis, proteomics

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**Development of the use of bioassays for chemical and environmental risk assessment**

**TH194 Responses to PFOA and PFBS exposure in the sediment dwelling invertebrate Dendrobaena veneta (Annelida)**

P. Iatrou, L. Guidolin, University of Padua, Department of Biology; F. Macea, Regional Agency for the Environment, ARPA Veneto, Verona; L. Fabris, Lab. Operative Service - Verona; G. Santovito, N. Tormen, University of Padua, Department of Biology; S. Trabucco, University of Padova / Department of Biology; A. Vantini, Regional Agency for the Environment, ARPA Veneto, Verona / Lab. Operative Service - Verona; L. Tallandini, University of Padova / Department of Biology

The aim of this work was to investigate the effects of PFOA and PFBS on the aquatic invertebrate Dendrobaena veneta (Annelida), bioaccumulation patterns and cellular and biochemical responses in coelomocytes (mitochondrial and lysosomal membrane stability), and at tissue level (GPx and MTs), following the exposure to two perfluorinated alkyl acids (PFOA and PFBS) for short (72 h) and longer (14 and 28 days) times. The exposures were carried out in soil microcosms prepared with glass containers filled with 300 ml of soil humidified at 30% with PFOA or PFBS spiked water. As for the 72 h tests the exposures were performed, at two different nominal concentrations, i.e. 30% or 10% MAC-EQS (Maximum Acceptable Concentration-EQS) calculated by the Italian Working Group for the derivation of Environmental Quality Standard (EQS) while for the long time the PFOA, or PFBS, nominal concentrations were 30% of 5x MAC-EQS values. Different accumulation patterns were observed for PFOA and PFBS, with PFOA no longer accumulating between 14 and 28 days, while PFBS continues to be accumulated up to 28 days. Significantly higher coelomocyte mortalities than in the controls, with both compounds, were detected after the 14 and 28 days exposures. As for the lysosomal membrane stability significant decreases were detected both after the short and the long-time exposures. In the soft tissues primary data don't show significant differences between control and treated organisms regarding the GPx activity. A significant MT total decrease was detected after PFOA exposure, both at 14 and 28 days while after PFBS exposure only at 14 days. As for MT, because it has been reported that PFASs seem to increase ROS levels, we determined not only the total protein concentration but also the oxidized fraction (MTox). A significant increase in the MTox fraction in PFOA treatment after 28 days and in PFBS after 14 days was observed. Our results show, for this invertebrate organism, a higher PBFsbioaccumulation than PFOA and significant exposure effects to the two PFASs both in coelomocytes, the main immunodefensive system cells of the organism, and in the soft tissues. Further studies are planned to explore the mechanisms underlying these results.

**TH195 Toxicity of Per- and Polyfluoroalkyl substances on Chironomus dilutus for use in a relative toxicity model**

C.J. McCarthy, CH2M / Environmental Services; M. Stanaway, B. Muckey, Test America; C. Salice, Towson University / Environmental Science & Science Dept.; M. Wright, CH2M

Per- and polyfluoroalkyl substances (PFASs), including perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) are commonly elevated in soil and groundwater. High detection frequency and concentration has resulted in identification of PFAS as compounds of interest and as emerging contaminants due to their regulatory uncertainty. Published toxicological research to date relates to PFOA and PFOS only and for a limited number of organisms. The lack of robust and defensible ecotoxicity data on other PFASs hinders risk assessment and leads to unsupported risk management decisions. Given this gap in understanding of the additional compounds, the Strategic Environmental Research and Development Program (SERDP) is funding research of these additional PFAS and classes of organisms. This discussion will summarize the first phase of a SERDP research grant to address these needs. Tests were conducted with a common aquatic test species to identify patterns of relative toxicity between the PFASs. Chironomus dilutus tests included a 96-hour reference toxicant test, a 10-day range finding test, and a 20-day definitive bioassay. For shorter duration Chironomus tests, the main endpoint of interest was survival while for longer-duration tests (20 days), the more sensitive growth endpoint was measured. Opportunistic measures of defensibility were also included to enhance the understanding of potential toxicity to these compounds. Test results will ultimately be used in conjunction with concurrent testing being conducted with avian and reptilian model species to the same chemicals to develop a relative toxicity model. Endpoints measures from the aquatic species tests will be used to identify clear patterns of relative toxicity of the tested PFASs. Results will inform and prioritize PFAS testing on avian and reptilian test species. In addition, the relative potency patterns observed after aquatic testing will be reassessed upon completion of the upper trophic level exposure studies. Once all phases of toxicity testing are complete, the results will be used to help develop a
Interpretation of bioassay results in the context of the soil quality TRIAD approach.

The recentized standardized method ISO 19204 “Soil quality – Procedure for site specific ecological risk assessment of soil contamination (Soil quality TRIAD approach)” describes in a general way the application of three combined lines of evidence (chemistry, ecotoxicology and ecology) along a tiered approach. Regarding the ecotoxicological component, the TRIAD approach consists in carrying out a battery of bioassays on soil samples and to scale the results from all bioassays to calculate an ecotoxicological combined risk score In order to evaluate its applicability and the relevance of the proposed tools, INERIS used the soil quality TRIAD approach on an applied case: an open mine operated for 60 years and which the waste contaminated 100 years ago. The results of this study, compared to those of other authors, suggest that the TRIAD approach may be used to assess multiple risk factors in an applied context. This work is also an opportunity to discuss the generalization of the TRIAD method and the development of a more adapted approach for the environmental risk assessment.
50mM, sensitivities of GSH and GSSG were increased from 0.0034 to 0.0072 and 0.028 to 0.046, respectively. Detection limits of both GSH and GSSG were also significantly lowered as using higher concentration of ammonium acetate. This indicates that producing ammonium adducts followed by dissociating ammonium ions from adducts to protonate GSH and GSSG is important mechanism for protonation of these compounds with using ammonium acetate as a mobile phase additive. This enhanced detection was also coupled with ZEL (Zwitterion Extraction-Liquid) to investigate the recovery of both GSH and GSSG and achieved more than 100% recovery for GSH and around 100% recovery for GSSG. The achievement of higher recovery of GSH than 100% was because ZEL itself might not be oxidized to form GSSG. In addition, same method was also applied to ZEL exposed to different concentrations of a target chemical as well as 6 mg/L of H2O2, a negative control. The lowest concentration of GSSG in this work was 5.0 ng/ml, higher than its detection limit, 2.0 ng/ml. This is meaningful because it could not be achieved by other conventional methods and assays with higher detection limit than its original concentration. Therefore, we can conclude that our method could avoid underestimation to quantify biomarkers such as GSH and GSSG.

**TH202** Rapid analysis of bivalves' xenometabolome using High Resolution Mass Spectrometry  
D.A. Muñoz, Water and Soil Quality Research Group, Department of Environmental Chemistry, IDAEA-CSIC / Water Quality; M. Olmos, IDAEA-CSIC / Water and Soil Quality Research Group; M. Rambla-Alegre, IRTA; S. Monfort, N. Guilmot, Institute of Environmental Assessment and Water Research IDAEA-CSIC / Department of Environmental Chemistry; J. Diogène, IRTEC Marine Environmental Monitoring Subprogram; M. Farre, IDAEA-CSIC / Environmental Chemistry; M. Lopez de Alda, Institute of Environmental Assessment and Water Research; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry  
A large number of contaminants are released to the environment every day from residential, commercial and industrial uses. They are simultaneously present at different levels in aquatic ecosystems making a “cocktail” of hazardous substances. These xenobiotics interact with wild organisms and may be bioaccumulated. They can have negative implications from an environmental point of view, affecting wild life, but also they may be of great concern from a human health perspective, when they accumulate in highly consumed organisms like bivalves. Given that it is unrealistic to assess every possible combination of chemical substances accumulated by organisms, the major challenge now is to develop systematic ways of addressing these chemical mixtures, and to identify priority mixtures of potential concern. For this purpose, the profiling of the xenometabolome, or range of xenobiotics and their metabolites in an organism exposed to environmental contaminants, seems to be the way forward. In the present work, for the profiling of the xenometabolome, a fast analytical method has been developed for the extraction and identification of priority contaminants in bivalves from Ebros Delta, Spain. A literature research was done in order to gather all the information available regarding the Ebros Delta and possible sources of contamination. Taking into account, the identification of mixture of compounds representative of the different contaminant sources identified in the area was selected. This mixture including pesticides, plasticizers, antibacterials, preservatives, stimulants, and pharmaceuticals was used for a recovery study with three different bivalves types of high commercial interest such as mussel, oyster and cockle. QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) was used for the extraction and purification of the purposed extracts were injected in Orbitrap-Q-Exactive for identification and quantification of the priority contaminants. Twenty compounds including endocrine disrupting compounds, pesticides, and pharmaceuticals were extracted with recoveries ranging from 40.54 to 105.51 %. Quality parameters such as method detection and quantification limits, accuracy, and precision were studied. Besides, non-target analysis of other relevant contaminants that may be present in bivalves' xenometabolome is ongoing.  
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**TH203** River ecosystem: an ecosystem approach to evaluate the ecological risk linked to the human health protection  
L. Mancini, Istituto Superiore di Sanità / Department of Environment and Health; C. Puccinelli, Italian Institute of Health ISS / Department of Environment and Health; L. Tancioni, University of Rome Tor Vergata / Biology department; M. Carere, Italian Institute of Health ISS; E. D’Ugo, Italian Institute of Health ISS / Department of Environmental Health; L. Tancioni, Italian Institute of Health ISS / Department of Environmental and Health; R. Giuseppeetti, F. Chiadzonia, Italian Institute of Health ISS / Department of Environment and Health; S. Marchegiani, Istituto Superiore di Sanità / Department Environment and Health  
The anthropogenic pressure on river ecosystems can induce changes on their structural and functional characters as well as an increasing risk for human health. Over the last years an ecosystem approach mainly based on multilevel bioindicator methods has been adopted for assessing the risk for human health. The samples processing plays a key role in the environmental analysis. Samplings were carried out in an area characterized by strong anthropogenic pressures (Tiber River Central Italy). The water samples were processed using the technique of filtration and concentration, as suggested within the European project µAPWELL, at the same time, tests were carried out using raw water samples. The approach of this study is based on the following parameters: biological community (diatoms, macro invertebrates, macrophytes and fishes fauna); chemical–physical parameters, a set of eco-toxicological bioassays (Vibrio fischeri, Daphnia magna and Vicia faba), microbiological analysis (Salmonella spp, Staphylococcus spp, Clostridium spp, and Campylobacter jejuni vpi photolysis vial analysis) and sentinel HAV and HEV, Norovirus NoGI and NoGII, Reovirus, Enterovirus: A, B and C, Adenovirus: ADV40 and ADV41. The results of this study showed that the pre-concentration of larger amount of water improves both the contaminants detection within aquatic ecosystems and the ecological risk evaluation. The eco-toxicological analysis played a key aspect in the integrated approach to evaluate the ecological risk linked to the human health protection. The integrated approach adopted has been a useful tool to describe the ecological status of surface waters and the related risk for human wellbeing, providing a complete and organic vision of the qualitative state of the ecosystem. In conclusion these results highlighted the different levels of alteration and the potential need for the primary prevention and restoration, confirming that an ecosystem approach plays a key role in the ecological and human health risk assessments.

**TH204** INTEGRATED EXPOSURE AND EFFECT DATABASE TOOLS TO SUPPORT HAZARD AND RISK ASSESSMENT  
K. Korsaar, NIVA / Environmental Chemistry; Y. Li, G. Laovil, L. Vedal, Y. Song, NIVA Norwegian Institute for Water Research; S. Caciolli, Italian Institute of Health ISS / Department of Environment and Health; L. Tancioni, University of Rome Tor Vergata / Biology department; M. Carere, Italian Institute of Health ISS / Department of Environment and Health; S. Monfort, N. Guilmot, Institute of Environmental Assessment and Water Research; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry; H. Lin, National Taiwan University; C. Liao, National Taiwan University; C. CHEN, National Taiwan University / Chemistry department; H. Petersen, Norwegian Institute for Water Research  
Use of available exposure and effect data are key to performing hazard and risk assessment of pollutants, and compiling different sources of data are often done in a case-by-case manner. Processing data is thus cumbersome and time consuming, whereas the availability of data is a large source of uncertainty in resulting assessments. The NIVA Risk Assessment database (NIVA RAdB[SM]) has been developed as a module-based tool to facilitate the assembly, organisation, integration, visualisation and quality assurance of available exposure and effect information in order to feed up and perform consistent handling of relevant data. The NIVA RAdB[SM] compile available experimental and predicted (computational) effect data that range from molecular and cellular responses characterising the mode of action (MOA), typically derived from high-throughput and high-content (in vitro) bioassays, to (apical) adverse data derived from whole organism bioassays of potential regulatory relevance. These effect data are assembled within the context of Adverse Outcome Pathways (AOPs) by anchoring data to initial cellular responses referred to as molecular initiating events (MIE), to downstream key events (KE) at the cellular/organ level and finally to adverse outcomes (AO) at the individual or organism level. The resulting multi-level assemblies of data can be used in hazard assessment to identify the MOA of one or more stressors, to link molecular responses to higher organism level effects and to identify potential stressors among large collections of pollutants that can give rise to a given AO. The NIVA RAdB[SM] also support risk assessment by calculating risk quotients (RQs) of single pollutants and mixtures of these on basis of exposure (typically measured or predicted environmental concentrations) and effect data (typically NOEC, ECx, PNEC or Eqs values) and can identify risk drivers (most toxic chemicals), relevant toxic endpoints (i.e. MIE, KE and AO) and susceptible species for a given exposure scenario. Recent development associated with integration of non-chemical stressors such as ionizing and non-ionizing radiation. Examples on uses specific exposure scenarios will be presented to show the utility of the databases and the tools developed.  
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**TH205** Assessing exposure risk for marine bivalve Mytilus posed by microplastic polystyrene particles  
C. Sun, Y. Yang, National Taiwan University / Bioenvironmental Systems Engineering; H. Lin, National Taiwan University; C. Liao, National Taiwan University / Department of Bioenvironmental Systems Engineering  
**BACKGROUND**: Microplastics (MPs) are one of the most widespread emerging pollutants in aquatic ecosystems, posing impacts on marine organisms. However, little is explored for potential risks of environmentally relevant concentrations of MPs or MPs by quantifying their impact on marine bivalve Mytilus posed by environmentally relevant concentrations of polystyrene microplastics (PS-MPs) and MPs based on bioassay results from related published literature.  
**METHODS**: We used Hill-based dose-response model to simulate the effects of PS-MPs on the lysosomal destabilization and phagocytosis in bivalves. The predicted no-effect concentrations (PNECs) causing 1% inhibition of immune function were also estimated. The inverse risk-based probabilistic model was used to characterize the potential hazards of marine bivalves in response to predicted environmental concentrations (PECs) of PS-MPs or MPs by quantifying exceedance risks (ERs) and hazard quotients (HQs) in five plastic-filled gyres.

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RESULTS: We found that PNECs for inhibition of lysosomal membrane stability and phagocytic cells were 0.04 and 0.07 μg mL⁻¹, respectively, implicating that phagocytosis is a more sensitive endpoint for immune responses in bivalves. In addition, our results demonstrated that the North Pacific Ocean appeared to be the greatest risks among global oceans. CONCLUSIONS: The strict thresholds estimated by applying a environmental risk assessment framework could be recommended as a criteria for environmental management of PS-MPs or MPs. Potential effects of PS-MPs/MPs on marine organisms at higher trophic levels should also be taken into consideration. Keywords: Polystyrene microplastics; Bivalve; Environmental risk assessment; Predicted no-effect concentration; Predicted environmental concentration; Hazard quotient

TH207
Innovative Design of Nationwide Dutch Water Quality Monitoring
M. de Baat, University of Amsterdam / IBED-FAME; Y. Coolen, D. van der Poux Kraan, R. Rood, University of Amsterdam / Department of Freshwater and Marine Ecology; M. Kraak, University of Amsterdam / IBED-FAME

According to the European Union Water Framework Directive (EU-WFD) chemical surface water quality is assessed by analysing the concentration of 45 priority compounds. However, the analysed chemicals are often absent and biological effects are thus caused by (unknown) mixtures of compounds. Alternatively, water quality can be assessed by observing adverse effects of surface water on test organisms. Therefore, the present study aimed to innovate surface water quality assessment by applying an innovative design in a nationwide monitoring campaign in The Netherlands. To this purpose bioassays with two aquatic invertebrate species, Daphnia magna and Chironomus riparius, were employed and the performance of passive sampling techniques to include time integrated compound concentrations was explored. D. magna neonates and C. riparius larvae were exposed to surface water samples from 34 locations. Daphnids were additionally exposed to POCIS passive sampler extracts from 7 of the reference locations. For the daphnids, none of the surface water samples or passive sampler extracts caused significant mortality after 48h of exposure. In contrast, for the chironomids, three surface water samples caused significantly lower larval survival compared to the controls. The use of C. riparius bioassays thus allowed for differentiation between water quality of the sampling locations. Possible explanations for the observed chironomid mortality include insecticide sorption to the provided food, which may lead to increased exposure resulting in higher mortality. A possible culprit compound could be the neonicotinoid imidacloprid, which was detected at two locations with observed chironomid mortality. Moreover, toxicity of imidacloprid to C. riparius is 500 times higher than to D. magna. This could thus explain the high mortality at these greenhouse locations. It is clear that further bioassays with multiple test species provides better insight into surface water quality, and is therefore a valuable addition to regular water quality monitoring.

TH208
Smart Monitoring: Application of innovative tools in nationwide water quality assessment
J. Novak, Masaryk University / RECETOX; Z. Tousova, B. Vrana, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxicon Compounds in the Environment; F. Smedes, RECETOX / Environmental chemistry and modelling; R. Grabic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocosmaceae; S. Aït-Aissa, INERIS / UMR SYBIO ECOT; M. Smatna, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxicon Compounds in the Environment; K. Hilscience, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxicon Compounds in the Environment

EU commission Water Framework Directive considers employment of passive sampling and use of effect-based tools in the monitoring of aquatic pollution. A combination of both approaches was used for monitoring of two rivers differing significantly in pollution levels. The Bosna, moderate-sized river in Bosnia-Herzegovina, which is burdened by untreated wastewaters, was sampled by semipermeable passive sampling devices (SPMD) and POCIS samplers. The Danube, the largest river in the EU with relatively low pollution level, was sampled using a mobile dynamic passive sampling device with silicone rubber (SR) and SDB-RPS Empore™ (ED) disc samplers. Both sampler sets consisted of partitioning sampler for non-polar chemicals (SPMD, SR) and adsorption sampler for the polar-ones (POCIS, ED). For the partitioning samplers, concentrations of collected chemicals in river water were derived using dissipation of performance references compounds. For the adsorption samplers, the sampling rates were either taken from literature (POCIS) or calculated from measured partitioning coefficients. The samples were analyzed for aryl hydrocarbon-, estrogen- and androgen receptor-mediated effects using in vitro bioassays. The effects were expressed as bioanalytical equivalents (BEQar) of respective model compounds in water. The BEQar levels were significantly in extracts from POCIS and ED samplers showing that the polar chemicals were responsible for most of the detected effects. Chemical analyses detected 103 and 209 chemicals in the Bosna and the Danube samples, respectively. The passive sampling allowed detection of chemicals at pg/L concentrations. The levels of chemicals with known biological potency for the studied endpoints were used for modeling of bioanalytical equivalents (BEQamu). The concentration of bioanalytical equivalents showed that the detected chemicals explained mostly a low fraction of the BEQamu. Only in the case of estrogenicity in extracts of the samplers collecting polar chemicals, the BEQamu was comparable with the BEQar levels. Both sampler combinations proved to be suitable for the detection of a large set of chemicals even at trace levels and for the complementary assessment of the biological potentials of the contaminants. The SOLUTIONS Project was supported by the 7th Framework Programme EU (FP7-ENV-2013) with grant agreement no. 603437.

TH210
Testing of realistic contaminant mixtures with the harpacticoid copepod species Nitocra spinipes using passive sampler extracts
M. de Baat, University of Amsterdam / IBED-FAME; R. van der Oost, Watermet / Onderzoek en Advies; P. de Vooigt, University of Amsterdam / IBED; P. Verdonkshout, University of Amsterdam / Department of Freshwater and Marine Ecology

The European Union Water Framework Directive requires member states to assess chemical water quality of surface waters by monitoring the presence of 45 priority substances. However, these substances are often banned and their concentration in surface waters is strongly decreased, frequently to levels below the limits of detection. Simultaneously, industries have switched to a myriad of alternative compounds that have serious impacts on water quality. Consequently, a large portion of the observed toxic effects of priority compounds. However, the analysed chemicals are often absent and biological effects are thus caused by (unknown) mixtures of compounds. Alternatively, water quality can be assessed by observing adverse effects of surface water on test organisms. Therefore, the present study aimed to innovate surface water quality assessment by applying an innovative design in a nationwide monitoring campaign in The Netherlands. To this purpose bioassays with two aquatic invertebrate species, Daphnia magna and Chironomus riparius, were employed and the performance of passive sampling techniques to include time integrated compound concentrations was explored. D. magna neonates and C. riparius larvae were exposed to surface water samples from 34 locations. Daphnids were additionally exposed to POCIS passive sampler extracts from 7 of the reference locations. For the daphnids, none of the surface water samples or passive sampler extracts caused significant mortality after 48h of exposure. In contrast, for the chironomids, three surface water samples caused significantly lower larval survival compared to the controls. The use of C. riparius bioassays thus allowed for differentiation between water quality of the sampling locations. Possible explanations for the observed chironomid mortality include insecticide sorption to the provided food, which may lead to increased exposure resulting in higher mortality. A possible culprit compound could be the neonicotinoid imidacloprid, which was detected at two locations with observed chironomid mortality. Moreover, toxicity of imidacloprid to C. riparius is 500 times higher than to D. magna. This could thus explain the high mortality at these greenhouse locations. It is clear that further bioassays with multiple test species provides better insight into surface water quality, and is therefore a valuable addition to regular water quality monitoring.

TH210
Passive sampling in effect-based monitoring of two European rivers - extractability of in vitro bioassays and chemical effects of priority compounds
J. Novak, Masaryk University / RECETOX; Z. Tousova, B. Vrana, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxicon Compounds in the Environment; F. Smedes, RECETOX / Environmental chemistry and modelling; R. Grabic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocosmaceae; S. Aït-Aissa, INERIS / UMR SYBIO ECOT; M. Smatna, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxicon Compounds in the Environment; K. Hilscience, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxicon Compounds in the Environment

EU commission Water Framework Directive considers employment of passive sampling and use of effect-based tools in the monitoring of aquatic pollution. A combination of both approaches was used for monitoring of two rivers differing significantly in pollution levels. The Bosna, moderate-sized river in Bosnia-Herzegovina, which is burdened by untreated wastewaters, was sampled by semipermeable passive sampling devices (SPMD) and POCIS samplers. The Danube, the largest river in the EU with relatively low pollution level, was sampled using a mobile dynamic passive sampling device with silicone rubber (SR) and SDB-RPS Empore™ (ED) disc samplers. Both sampler sets consisted of partitioning sampler for non-polar chemicals (SPMD, SR) and adsorption sampler for the polar-ones (POCIS, ED). For the partitioning samplers, concentrations of collected chemicals in river water were derived using dissipation of performance references compounds. For the adsorption samplers, the sampling rates were either taken from literature (POCIS) or calculated from measured partitioning coefficients. The samples were analyzed for aryl hydrocarbon-, estrogen- and androgen receptor-mediated effects using in vitro bioassays. The effects were expressed as bioanalytical equivalents (BEQar) of respective model compounds in water. The BEQar levels were significantly in extracts from POCIS and ED samplers showing that the polar chemicals were responsible for most of the detected effects. Chemical analyses detected 103 and 209 chemicals in the Bosna and the Danube samples, respectively. The passive sampling allowed detection of chemicals at pg/L concentrations. The levels of chemicals with known biological potency for the studied endpoints were used for modeling of bioanalytical equivalents (BEQamu). The concentration of bioanalytical equivalents showed that the detected chemicals explained mostly a low fraction of the BEQamu. Only in the case of estrogenicity in extracts of the samplers collecting polar chemicals, the BEQamu was comparable with the BEQar levels. Both sampler combinations proved to be suitable for the detection of a large set of chemicals even at trace levels and for the complementary assessment of the biological potentials of the contaminants. The SOLUTIONS Project was supported by the 7th Framework Programme EU (FP7-ENV-2013) with grant agreement no. 603437.
5, 6 and 7 days to calculate the larval development ratio. Results showed no statistically significant developmental effects for all tested extracts. The tested concentrations after solvent spiking in our test system were slightly below environmentally realistic contaminant concentration levels. Overall the larvae showed to be unaffected by the exposure to the Speedisk™ extracts and we expect no direct effects of environmentally realistic contaminant mixtures on the development of N. sinnipes.

TH211 Passive dosing of polar and non-polar substances using Oasis HLB® - Pre-equilibration of media for transferring complex mixtures.

D. Kämper, Institute for Environmental Research (RWTH · Aachen University) / Institute for Environmental Research (Bio V); T. Seeler, RWTH Aachen University / Ecosystem Analysis; H. Hollert, K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

The passive dosing approach is currently focused on hydrophobic organic substances. Dosing phases such as polydimethylsiloxane (PDMS) silicone are suitable for this task, but also limit the approach to specifically this group of substances. However, metabolism, volatilization and sorption – particularly medium sorption – are also highly relevant for polar substances. Therefore, a requirement for the passive dosing of these substances also exists. To overcome the current limitations of silicone, the applicability of Oasis HLB for dosing polar and non-polar substances was tested in a neutral red assay. The findings show a high affinity of Oasis HLB towards certain substances. In vitro bioavailability, disrupt enzymes, generate oversaturated solutions) triggered the potential impact on results (e.g. could impact transmembrane permeation, increase cytotoxicity, sample was fractionated by using reversed phase-high performance liquid chromatography (RP-HPLC) by using C-18 silica based column. Two minute fractions were collected (total 30 fractions) and applied on respective bioassays and identified one agonistic active fraction for both PR and GR. Second step fractionation was performed on the only active fraction by using aninotropic column with gradient elution with methanol-water (50:70) with 0.1% formic acid. One to two minute fractions (total 28 fractions) were collected and biological analysis of these sub-fractions revealed again one active fraction with reduced potency as compared to F18 (parent fraction). For unraveling the compounds responsible for gestagenic and corticoid activity, non-target screening is being performed by using LC-HRMS.

TH214 Mixture Risk - Development of an effect-based chemical risk assessment strategy for sites contaminated with complex mixtures of organic and inorganic contaminants.

G. Nilen, B. Holmes, M. Larsson, Orebro University / M. Larsson, Orebro University / Man-Technology-Environment research centre (MTM); N. Scherbak, Orebro University / School of Science and Technology, Life Science Centre; M. Engwall, Orebro University / Man-Technology-Environment research centre (MTM); S. Keiter, Orebro University / MTM Research centre

Environmental contamination is usually comprised of a mixture of pollutants, each of them bearing the potential of causing different toxic responses towards humans and wildlife. Recent risk assessments still generally rely on chemical analyses only; however, such investigations do not provide information regarding the interactions between chemicals including their integrated toxicity. The limited knowledge of the risks associated with mixture toxicity is the starting point for this study, and is part of the EnForce project that aims to investigate the toxic responses of mixtures of pollutants and integrate those results into risk assessment. Particularly, per- and polyfluorinated alkyl substances (PFAS) are of major concern as they are extremely persistent and able to alter the toxicity of other pollutants. However, preliminary results showed that selected PFASs were not able to alter mechanism-specific toxic effects in vitro, while they decreased gene expression of the same mechanism using an in vivo model with zebrafish embryos. Moreover, so far no vertebrate based test system exists to quantify the toxic response of PFASs; thus, one objective of the project is to develop a bioanalytical tool for measurement of PFAS contamination. The toxic effects of environmental samples will be assessed by a combination of biotests and chemical analysis. For the identification of non-target pollutants, effect-directed analysis will be used consisting of fractionation, chemical analysis and biotests. In addition, the project aims to fill crucial gaps in the knowledge regarding molecular and biological effects of PFAS in vitro test systems, and becomes highly challenging when dealing with hydrophobic (logK OW > 3.5) and volatile substances like some fragrances. Historically, solvents were used to enhance the solubility, but their potential impact on results (e.g. could impact transmembrane permeation, increase bioavailability, disrupt enzymes, generate oversaturated solutions) triggered the search for alternative solutions. Passive dosing has proven to be effective to generate solutions of truly dissolved substances at controlled and constant concentrations. To increase the robustness of in vitro alternative approaches, involving permeation and biotransformation, to the fish bioconcentration test, we set up a global strategy to prepare solutions of hydrophobic substances using customized PDMS-reservoirs. These tube-shaped reservoirs were used either in static mode to prepare the test solutions for the in vitro biotransformation test with rainbow trout S9 or hepatocytes, or in dynamic mode to maintain a constant concentration in a selected compartme.
TH216 Ecotoxicological assessment of water samples from an urban river, wastewater treatment plant effluent and industrial effluent in Hyderabad (India) using a set directed analysis battery

P. Subha, J. Dana, RWTH Aachen University / Department of Ecosystem Analysis; J. Ahlhelm, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; A. Dayakar, Gama NGO Hyderabad; A. Sathish Lekha, J. Vijayan, I.M. Nambi, Indian Institute of Technology Madras / Department of Civil Engineering; V. Schiller, RWTH Aachen University / Department of Environmental Research UFZ / Effect-Directed Analysis; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research, Dept. of Environmental Analysis; S. Schiwy, Institute of Environmental Research-RWTH Aachen / Department of Ecosystem Analysis; T. Schlüte, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; H. Hollett, RWTH Aachen University / Department of Environmental Research UFZ / Effect-Directed Analysis; D. Haas, Freie Universität Berlin / Department of Environmental Research UFZ / Effect-Directed Analysis; J. Meili, Swiss Centre for Applied Ecotoxicology Eawag / Ecotoxicological characterization of an urban Indian river and potentially raise awareness of possibly high toxicity observed in the sediments. The contamination of surface water is a common issue in urban areas of India. Large proportions of urban river water may consist of untreated wastewater, both domestic and industrial. The city of Hyderabad (Telangana state, India) has large industrial clusters including pharmaceutical, dye and battery factories that have the potential to affect surrounding waterbodies. Recent studies on antibiotic resistances proposed pharmaceutical industries as a potential cause for antibiotic resistances in bacteria in surface waters of Hyderabad. Daily contact of cattle and cattle herding shepherds as well as monsoon flood events are only two examples in which the river pollution is not only an environmental risk but also a human health issue. To work towards a more sustainable water management in urban areas of India, a cooperation between environmental engineers from the Indian Institute of Technology Madras and ecotoxicologists from the Department of Ecosystem Analysis (ESA), RWTH Aachen University and environmental chemists from the Helmholtz Centre for Environmental Research Leipzig (UFZ) has been formed. For a complementary assessment to previous studies, water samples were extracted from an urban river (Musi river), its tributary, the effluent of a wastewater treatment plant and industrial wastewater, in Hyderabad in June 2017. The samples were taken using a novel device for onsite large-volume solid phase extraction (DOE 10.1016/j.scitotenv.2016.12.140) with a defined extracted water volume between 40 and 100 L per sample over 4 to 8 hours. The resulting water extracts will be investigated through non-targeted and target chemical analysis as well as effect-directed analysis (EDA). A bioassay battery to investigate the toxicological effects of the samples included algae (Pseudokirchneriella subcapitata) growth inhibition, daphnia (Daphnia magna) immobilization, fish embryo toxicity (Danio rerio), endocrine disruption (lyticeae Yeast Estrone Screening; ER-CALUX), genotoxicity (Ames fluctuation; micro nucleus test), neurotoxicity (D. rerio) and dioxin-like activity (micro EROD), these tests are currently ongoing. Preliminary results indicate adverse effects on P. subcapitata, D. magna, as well as endocrine disruption in the lyticeae Yeast Estrone Screening in four out of five samples. The combined results of this work will provide a comprehensive ecotoxicological characterization of an urban Indian river and potentially raise awareness of possibly related risks.

TH217 NAWA SPEZ 2015: Ecotoxicological risks in five small Swiss streams within agricultural catchments

M. Langer, Centre Ecotox EAWAG-EPFL / Aquatic Ecotoxicology; M. Jungkans, Centre Ecotox EAWAG-EPFL; S. Spycher, Eawag Swiss federal Institute of Aquatic Science and Technology; M. Koster, Amt für Umwelt, Thurgau; Gewaesserqualitaet; C. Baumgartner, AquaPlus; E. Vermeiren, Ecotox Centre Eawag-EPFL / Aquatic Ecotoxicology; I. Werner, Ecotox Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology

The Swiss National Monitoring of Surface Water Quality (NAWA) is occasionally complemented by focused studies on relevant topics. The latest focus study evaluated pesticides in sediments and in catchments of urban agricultural land use. For this purpose five small streams were sampled from the beginning of March to the end of August using half-day composite samples and an analytical method covering 213 active substances. The chemical analysis was complemented with several biological investigations. Measured concentrations of pesticides were used to determine the risk of pesticide mixtures. Using acute and chronic effect-based water quality based criteria (QC), we calculated risk quotients (RQ). In a second step RQs of individual compounds were summed to provide separate mixture RQmix for plants, invertebrates and fish. In all the tested water bodies a chronic mixture risk with RQmix > 1 was determined. There was a chronic mixture risk at three sites for almost the entire sampling period. Consequently this resulted in no recovery time for aquatic organisms. An acute mixture risk was determined for four streams, with two of them showing high risks with RQmix greater than 10. In addition it was investigated to what extent the predicted mixture risk of herbicides was consistent with endpoints that are determined in the combined algae test. This test provides information on the inhibition of photosystem II (PS II) and alga growth. The resulting risk corresponded very well with the calculated mixture risk for PS II inhibitors. In one stream PS II inhibiting plant protection products dominated the ecotoxicological assessment. For Lake Mondsee was carried out. Water (W) and sediment (S) samples were collected from Lake Mondsee and the reference site, Lake Irsee, on three different seasons: 1) summer 2015 (preliminary assessment of W and S samples’ toxicity), 2) spring 2016 (possible best-case scenario, since lake was frozen for the winter) and 3) summer 2016 (worst-case scenario, tourist activities peak). The WWTP inflow and outflow, plus pre-thickening (PS) and thickened sludge (TS) were also collected. The toxicity assessment for summer 2015 was made by performing 48-h population growth (r) assays with the rotifer Brachionus calyciflorus (W samples) and the 15-min luminence inhibition assay with the bacterium Vibrio fischeri (all samples). Regarding the W samples, results showed no luminescence inhibition for V. fischeri and average r inhibition rate (%) of B. calyciflorus was below 26%. The WWTP inflow samples presented high toxicity to B. calyciflorus (EC50 > 60%). Samples of S, PS and TS were extremely high toxic to V. fischeri. The samples collected during spring 2016 and summer 2016 were analysed through a battery of assays, with species belonging to different trophic levels. In addition to the two above mentioned tests: the 72-h growth inhibition test with Raphidocelis subcapitata and the feeding inhibition test with Brachionus calyciflorus. For TS samples the 6-day mortality and growth assessment with Heterocapsa incongruens for PS, S and TS samples. Regarding spring 2016, the average r inhibition rate (%) of B. calyciflorus was lower than 30% for most of the W samples and average did not surpass 12%. The Microtox® tests showed high toxicity only for all W, SPS and TS samples. Samples collected in the summer 2016, showed similar results for the growth inhibition for R. subcapitata of Microtox® test. The r-inhibition of PS, TS and S of B. calyciflorus and the 6-day mortality and growth assessment with H. incongruens showed some variation. No evidences of the influence of the WWTP present at lake Mondsee were retrieved, since W and S samples from both Lakes Mondsee and Irsee showed similar toxicity. Further chemical analysis is necessary to clarify the high toxicity observed in the sediments.

TH219 Availability of estrogens applied onto 96-well plates in the LYrE

M. Ragulan, Swiss Centre for Applied Ecotoxicology Eawag-EPFL; E.
TH220 Mutagenic and ontogenetic responses in freshwater guppy Poecilia vivipara chronically exposed to waterborne sodium dodecyl sulfate (SDS)

L.C. Penha, Federal University of Maranhão - UFMA / Departamento de Ciências Biológicas; D.B. Boaes, Federal University of Maranhão - UFMA / Instituto de Correntes do Mar-ICmar; M. Jorge, Universidade Federal Maranhão - UFMA / Instituto de Oceanografia e Limnologia; R.L. Santos, Federal University of Maranhão - UFMA / Instituto de Ciências do Mar-ICmar

The deposition and persistence of some chemicals in aquatic environments is a constant threat to aquatic organisms. Sodium dodecyl sulfate (SDS) is a surfactant widely used as an emulsifier in household products and is constantly present in the environment. This study was conducted to evaluate the mutagenic (nuclear abnormalities) and ontogenetic (embryo formation) responses in freshwater pregnant female of guppy *Poecilia vivipara* chronically exposed to waterborne sodium dodecyl sulfate (0.3 and 10 mg/L) for 90 days. In the control group, eggs were fixed in 10% neutral buffered formalin and analyzed for nuclear abnormalities. After exposure, females' blood was analyzed for nuclear abnormalities (micronucleated cells, nuclear buds, binucleated cells and cells with multinucleated fragments), and non-parity females were submitted to cesarean section for embryo classification of development stage (less developed until completed newborn fish). The results demonstrated that there were no external deformities in the newborn fish during the exposure. However, there was a decrease in the number of fry on the females exposed to both concentrations of SDS in relation to the control, as well a delay in the development of the embryos of the exposed females, indicating ontogenic effects even at low concentrations of SDS (0.3 mg/L). The results indicate that freshwater *Poecilia vivipara* chronically exposed to SDS does not appear to be protected by European Directive (73/105/EC) that allowing the concentration of 0.5 mg/L of anionic surfactants (such as SDS) in drinking water and 1 mg/L in the freshwater used for other purposes.

TH221 Determination of Izmir Bay Pollution by Using Genetic Biomarkers in the Mussel (Mytilus galloprovincialis) taken from the Natural Environment

A. Arslan, University Ege / Hydrobiology; H. Parlab, Ege University; M. Boyacioglu, Ege University, M. A. Karaaslan, University of Ege; G. Glißver, Ege University

Izmir Bay, which is surrounded by many agricultural and industrialized cities like Izmir and Manisa, has been polluted nearly 50 years. Aquatic ecosystems were affected very badly due to much kind of pollutants such as heavy metals, polycyclic aromatic hydrocarbons (PAH), Polychlorinated Biphenyls (PCB) and Pesticides. Besides agricultural and industrial activities, heavy marine transport and redging activities in the harbor activities are also disturbed Izmir bay. Authorities have decided to take serious action when the effects of pollution were unbearable in 1980,- as all the city smell very badly. Micronuclei (MN) tests is a system of micronucleus testing used to detect the DNA damage in micronuclei of interphase cells. Damage caused on the DNA by genotoxic pollutants is the first consequence occurring in the aquatic organisms. In this study, we aimed to investigate the genotoxic effects of Izmir Bay by detecting the MN frequency changes in the gills of mussels (*Mytilus galloprovincialis*). According to our results MN frequency of 10 stations varied between %39.33 - %5.60 and Binucleated cells frequencies were 0.17 – 5.27. Pollution of Izmir Bay is a long story and cannot be healed in short time but there are some signs that it is in the healing trend. Key Words: Izmir Bay, Pollution, micronucleus, *Mytilus galloprovincialis*

TH222 Bioassays stress the ecotoxicological differences between polymers and plastics additives in the marine environment

r. beiras, University of Vigo / Toralla marine sciences station (ecimat); L. Mantilla-Aldana, P.C. López, University of Vigo / Ecology and Animal Biology; T. Tato, Universidade de Vigo / ECIMAT; L. Vidal-Lifán, IEQ

Commercial objects made of plastics are composed of two different components with dissimilar ecotoxicological properties, namely the polymer matrix and the chemical additives used to provide the final physical and chemical properties demanded by the consumers. Most conventional polymers are made of innocuous monomers (olefins, terephthalates), they are inert under environmental conditions and, according to standard ecotoxicological bioassays using early life stages (zoea), do not pose toecotoxicological risks to marine organisms, with the possible exception of mechanical damage. In contrast, many common plasticizers (e.g. orthophthalates), flame retardants (polybrominated and organophosphorus chemicals), UV filters (benzophenones and other aromatics) and biocides (triclosan) have shown sublethal toxicity for the reproductive and endocrine systems of aquatic organisms. Those potential effects are difficult to detect in laboratory since they may result from long exposure times and plastic organism interactions not considered in standard toxicity tests. Using ELS of marine organisms, we have adapted standard bioassays with ELS, tested `virgin` microparticles of conventional polymers (PE, PS, PVC) and did not find any relevant short-term toxicity. In contrast, when microparticles obtained from commercial plastic objects are used events of acute toxicity are found, pointing at the additives as the causal agents of the toxicity found. Ongoing experiments explore the kinetics of additive leaching and resulting toxicity in order to assess the relevance of the results under environmental conditions. In addition, some commonly used chemical additives of plastics were also tested and some of them did show acute toxicity at levels not far above those found in polluted coastal waters. The overall experimental evidence obtained so far using standard bioassays with ELS of marine invertebrates point at certain chemical additives as ecotoxicologically unacceptable and stresses the need of finding non-toxic alternatives useful for the industry.

TH223 EFFECTS OF POTASSIUM BROMATE ON THE EMBRYOLOGICAL DEVELOPMENT OF THE SEA URCHIN Arbacia lixula (Linnaeus, 1758)

M. Jorge, University of Vigo / Hydrobiology; D.Z. Ayar, Les Etablissements Scolaires Tétefik Fikret; G. Kenanoglu, Turkish Education Foundation Inanş, Türkiye private high school; M.A. Karaaslan, University of Ege; S. tez, Ege University Potassium bromate is a powerful oxidizing agent that chemically ages flour much faster than water. Potassium bromate leaches chlorine, which gives the formation of tiny, thin-walled bubbles as the bread rises. The product is fluffy, soft and unnaturally white. In this investigation, the embryootoxic, spermototoxic effects of Potassium bromate analyzed during the development of the sea urchin *Arbacia lixula* from the post-fertilization to pluteus stage (72-h). Moreover, effects of Potassium bromate on fertilization success were observed. Sea urchin sperms and eggs were exposed to Potassium bromate for 20 min and only exposure times to plasticicogen organs interactions not considered in standard toxicity tests. Using ELS of marine organisms, we have adapted standard bioassays with ELS, tested `virgin` microparticles of conventional polymers (PE, PS, PVC) and did not find any relevant short-term toxicity. In contrast, when microparticles obtained from commercial plastic objects are used events of acute toxicity are found, pointing at the additives as the causal agents of the toxicity found. Ongoing experiments explore the kinetics of additive leaching and resulting toxicity in order to assess the relevance of the results under environmental conditions. In addition, some commonly used chemical additives of plastics were also tested and some of them did show acute toxicity at levels not far above those found in polluted coastal waters. The overall experimental evidence obtained so far using standard bioassays with ELS of marine invertebrates point at certain chemical additives as ecotoxicologically unacceptable and stresses the need of finding non-toxic alternatives useful for the industry.

TH224 DETERMINATION OF IZMIR BAY POLLUTION BY USING GENETIC BIOMARKERS IN THE MUSSLE (MYTILUS GALLOPROVINCIALIS) TAKEN FROM THE NATURAL ENVIRONMENT

A. Arslan, University Ege / Hydrobiology; H. Parlab, Ege University; M. Boyacioglu, Ege University, M. A. Karaaslan, University of Ege; G. Glißver, Ege University

Izmir Bay, which is surrounded by many agricultural and industrialized cities like Izmir and Manisa, has been polluted nearly 50 years. Aquatic ecosystems were affected very badly due to much kind of pollutants such as heavy metals, polycyclic aromatic hydrocarbons (PAH), Polychlorinated Biphenyls (PCB) and Pesticides. Besides agricultural and industrial activities, heavy marine transport and redging activities in the harbor activities are also disturbed Izmir bay. Authorities have decided to take serious action when the effects of pollution were unbearable in 1980,- as all the city smell very badly. Micronuclei (MN) tests is a system of micronucleus testing used to detect the DNA damage in micronuclei of interphase cells. Damage caused on the DNA by genotoxic pollutants is the first consequence occurring in the aquatic organisms. In this study, we aimed to investigate the genotoxic effects of Izmir Bay by detecting the MN frequency changes in the gills of mussels (*Mytilus galloprovincialis*). According to our results MN frequency of 10 stations varied between %39.33 - %5.60 and Binucleated cells frequencies were 0.17 – 5.27. Pollution of Izmir Bay is a long story and cannot be healed in short time but there are some signs that it is in the healing trend. Key Words: Izmir Bay, Pollution, micronucleus, *Mytilus galloprovincialis*
Effect of thermal stress on endocrine disruption in *Daphnia magna*

J. Na, Korea University; H. IM, J. Jung, Korea University / Environmental Science and Ecological Engineering

Endocrine disrupting chemicals (EDCs) include various types of natural (17β-estradiol, estrone) and synthetic (nonylphenol, bisphenol-A) compounds presenting inhibition or mimicking of the reproductive action of endocrine system in animals and humans. Recently, several studies reported that daphnid species which reproduce by parthenogenesis may generate male offspring in response to EDCs. In addition, it was demonstrated that variation of water temperature is able to change reproduction, growth, and survival of aquatic organisms and population number. This study aims to evaluate the effect of thermal stress on endocrine disrupting effect of EDCs using *Daphnia magna*. Short-term screening (STS) assay was performed to investigate the endocrine disruption effects in adult (10-17 days old) daphnids. Animals were exposed to two temperatures of 20 °C and 25 °C, and reproduction, growth, male production and survival rates were evaluated. This study can give a insight into the endocrine disrupting effects of EDCs on aquatic organisms under influence of thermal effluents discharged into streams and rivers.

**TH225**

Microplate Alga Growth-Inhibition Bioassay

I. Iturria, O. Jaka, C. Martí, A. Alzualde, BioBide; A. Muriana, BBD BioPhenix S.L. / RD

The development of new chemical compounds is a long and costly process that may span up to 10 years. However, the success rate of new chemical families has decreased exponentially in the last decades mainly due to compounds toxicity detected in later phases of the R&D process. The OECD publishes a series of guidelines to define the toxicity evaluation assays required for regulatory purposes. The 201 guidelines, in particular, describes the alga growth inhibition test for the evaluation of aquatic toxicity. Nevertheless, the procedure is tedious and time-consuming, so it’s not suited for high throughput screening of toxicity on early development phase. Given so, there is a need for faster and cost-effective assays with an increased throughput to assess the aquatic toxicity of a compound in early phases of the development. In this work, we present a miniaturized version of the OECD 201 alga growth inhibition test. The miniaturized test is carried out in 96 well plates and the biomass measurement is performed on a plate reader. The methodology makes possible to test ten concentrations of a compound and a negative control on the same plate. The biomass measurement by fluorescence read produces a sensitive and reproducible measurement of alga concentration in an efficient manner, with a significant time and human labor reduction. The alga microplate assay was validated with environmentally relevant reference compounds (such as pesticides or flame retardants) and the resulting EC50 values were compared to the OECD 201 results.

**Challenges, methodological developments and practical solutions for Social Life Cycle Assessment in industry and policy (P)**

**TH226**

Applying Social-LCA and Social Hot Spot Analysis including a SDG Evaluation to Product Assessments with SEEBALANCE®

P. Salino, BASF SE / Sustainability Strategy; A. Alba Perez, T. Gruenenwald, P. Koelsch, BASF SE / CDS/S

Social criteria and objectives – such as education, health or working conditions – are becoming increasingly important which is why these factors are also addressed by the SDGs (Sustainable Development Goals). For this reason, social aspects also have an increasing impact on marketing and management decision-making processes. In the SEEBALANCE® methodology, measures the ecological and economic consequences of alternative products or processes. The Eco-Efficiency Analysis is integrated to an overall result together with the Social Analysis (Figure 1).

**TH227**

Piloting Responsible Research and Innovation in Industry

E. Yaghmaei, I. Van de Poel, Delft University of Technology / Values, Technology & Innovation; A. Porcari, A. Ari - Italian Association for Industrial Research; E. Mantovani, E. Borsella, Italian Association for Industrial Research

There is now only limited experience with Responsible Research and Innovation (RRI) in industry and there is also limited evidence of the added value of opening up the innovation process in industry for social engagement and gender considerations. In the PRISMA project (http://www.rrr-prisma.eu), we overcome these current limitations by carrying out eight RRI pilot projects in a real-world industry context. To establish the added value of the RRI approach and its gender dimension in and for industry, we assess the pilot projects on a number of product and process RRI dimensions and compare the pilots on the relevant RRI dimensions with similar projects in the same companies in which the RRI approach has not been followed. We focus on implementing RRI for some of the major technological challenges in the EU including nanotechnology, synthetic biology, Internet of Things (IoT) and self-driving or automated cars.

**TH228**

Sustainable Guar Initiative - an integrated approach of social and environmental LCA

P. Martz, L'Oréal Research & Innovation / L'OREAL; P. Arsac, N. Zaaraoui, L’OREAL; A. Wathelet, Solvay SA / LCA; J. Viot, F. Laurent, Solvay SA; M. Vuillat, S. Causee, EVEA

Sustainable Guar Initiative (SGI) is a three-year long integrated program aiming at developing sustainable guar production within the Bikaner district in Rajasthan, India. This desert district is one of the largest producers of guar and guar gum in India. SGI was set up by Solvay, L’Oréal, HiChem and the NGO TechnoServe, and is based on 4 themes: (1) Agronomy: enhancing sustainable practices for rain-fed guar production, (2) Environment: groundwater-neutral approaches and best practices in guar farming, along with tree plantation, (3) Social impact: gender approaches, nutrition, health & hygiene and (4) Market improvement: traceability, supply chain and market access. Guar gum is extracted from guar seed and can be used as such, or functionalized. It is for example used as a bio-based thickening agent in personal care products. To confirm and consolidate the relevance of the program and to identify potential improvement opportunities, an environmental and social Life Cycle Assessment (LCA) is being undertaken, comparing the guar production before and after the SGI. The social LCA has been conducted following already available guidelines, including UNEP-SETAC Guidelines for Social Life Cycle Assessment of Products and WBCSD Social Life Cycle Metrics for Chemical Products. Methodological developments have furthermore been undertaken in order to fully take into account the smallholders. The Master’s thesis of Diana Indrane on “Integrating Smallholders within the Handbook for Product Social Impact Assessments” has been completed with some developments, related to: (1) Goal and scope: better identification of relevant stakeholders and social aspects, (2) Inventory: improvement of data quality among the social aspects, stakeholders or life cycle steps and (3) Performance assessment: common rating system enabling aggregation related to inventory from multiple sources. Besides environmental LCA, the poster will focus on social LCA. Methodological challenges encountered will be presented and solutions to tackle them will be detailed as long with other limits related to these new developments.

**TH229**

How the social pillar can be properly integrated into sustainability evaluation methodology? Evidence from bio-based products case study

P. Falcone, E. Imbert, A. Tani, V. Tartiu, P. Morone, Unitelma Sapienza University of Rome

**Abstract**

Along with environmental and economic assessment, social sustainability of the bioeconomy has become a growing challenge, with important effects on the market uptake of bio-based products. In recent years, social and socioeconomic aspects have progressively been included in both the discourses and sustainability analyses concerning the bioeconomy. Yet, when it comes to bio-based products the situation still lags behind (Siebert et al. 2017)[1], given that bio-based products involve longer and more complex value chains (Bell et al. 2014)[2] that make the assessment of social and socio-economic impacts extremely challenging. Furthermore, the success of a sustainable bioeconomy depends on the stakeholders’ acceptance – especially consumers and manufacturers – leading to a growth in demand for such products. The choice of ‘what to be measured’ is the critical point in S-LCA and, by employing recognised participative techniques, the stakeholders’ involvement can be used to shape the final sustainability criteria and regulatory recommendations. Against this background, our study aims at investigating to the social pillar in an LCA analysis of bio-based products, by identifying and validating the main social impact categories pertaining to the bio-based products realm. In doing so, we employ a robust three-step methodological framework encompassing: impact categories identification, stakeholders mapping, and social impact categories validation. In order to operationalize the methodological framework, empirical data is gathered by means of in-depth literature review, stakeholders’ interviews, and focus groups. By providing empirical evidence on the social dimension, which incorporates different visions of the stakeholders involved in the bio-based value chains, our study paves the way for further developments concerning the integration of social assessments within bioeconomy context. **Keywords:** bio-based products, social assessment, stakeholders analysis - bio-based products (Bell et al. 2014)[2] Siebert A., Bezamaa O’Keeffe K. 2017[3].

**TH230**

Methodological considerations for applying social LCA to modelled future European energy systems in the REFLEX project

N. Brown, KTH royal Institute of Technology / Sustainable Development, Environmental Science and Technology; E. Ekener, KTH royal Institute of Technology; M. Fuss, KIT Karlsruhe Institute of Technology / Institute for Technology Assessment and Systems Analysis ITAS; L. Xu, KIT Karlsruhe Institute of Technology

A methodology has been developed for the social assessment from a life cycle perspective of supply chains for future energy systems for the European Union

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(modelled techno-economically as part the Horizon 2020 project REFLEX). It has been developed in light of previously published work aiming at life-cycle based social and/or environmental assessment of single energy technologies and energy systems with a future perspective, and in careful collaboration with the handful of REFLEX partners responsible for energy systems models. The functional unit for the assessment of the future scenarios is the provision of energy services in the EU in 2050 (the final year of the scenario and modelling). The system boundary for the energy system is defined through supply chains required for the production and delivery of heat (in all sectors), electricity, and mobility services. Foreground LCI data for the capital equipment (primarily plant and vehicles) and fuels are taken from output data from energy systems models. Background LCI data about separate future energy technologies (as represented by the identified foreground processes noted earlier) start from existing LCI data for current systems (from Ecoinvent) to which changes are made based on certain assumptions about future developments of the technology in question. Thanks to the availability of price data for material in the latest version of Ecoinvent, LCI data acquired can be converted into monetary values. Finally, the cost data can be inputted into a multi-region IO-table linked worker hours model such as social hotspots database. This yields the country specific sectors required for the material in the energy system. The social impacts are then be evaluated with social theme tables for each country specific sector. It is proposed that IO-tables used should be adapted in order to reflect the development of the energy system in the future. Since the energy models and scenarios used in REFLEX are preserving in nature, it is suggested as a simplification that social impacts for the future system may resemble the current system for the methodology used, if doing so it is necessary to be clear about how such results should and should not be interpreted. The methodology will be operationalized in the coming year as part of the REFLEX project.

TH231 Social Life Cycle Assessment of the water system in Mexico City
M. García, Instituto de Ingeniería, UNAM / Ingeniería Ambiental; L. Güereca, Engineering Institute Universidad Nacional Autónoma de México / Environmental Engineering
One of the main elements of the sustainability of water systems in the cities, is to guarantee a decent job that promotes the welfare of workers in accordance with the objectives of sustainable development in Agenda 2030. Mexico City is one of the most populated cities in the world and is considered as the main political, economic and cultural centre of Mexico. However, it has been several water sustainability problems in the social aspect as risks to the health of workers of the water system. The activities of operation that they perform, are also subject to the aggravation of the problems such as professional development, and aging of the labour force. The objective of this research was to carry out an assessment of damages to human welfare of the workers, through a holistic and systemic approach to assess the impacts of each of the processes of the water system in relation to working conditions. The evaluation of the social impacts of the water system was based on methodological guidelines of S-LCA edited by USEPA/ETL/CLC and other instruments of social impact assessment. However, considering five stages of the water system: water abstraction and treatment, distribution, storage, water waste collection and wastewater treatment. The evaluation used the method of impact assessment with a nominal scale between 0 and 1, divided into five ranges of social performance: Without information, Bad, Medium, Good and Very Good. The results were that Water abstraction and treatment obtained a performance of Medium and the stage of Water waste collection obtained a performance of Medium and the stage of Wastewater Treatment, with a performance of Good. Any stage of the system has reached a Very good level in social performance. In conclusion according to the methodology used, which adopts a scale of 0 to 1, where 0 is the worst and 1 the best; it determines a score of 0.6 for all the analysed system, which places the system analysed in Good social performance, but is identified as priority needs like decrease of overtime in the drinking water and wastewater treatment plants; improve security conditions in the facilities in order to reduce the risks to health. The welfare of workers requires attention on these points to get closer to the definition of decent work.

Improvements in environmental exposure assessment: Development and application of tools across industry sectors, regulatory agencies, and international boundaries (P)

TH232 Environmental Risk Assessment for some additives used in hydrocarbon extraction activities into the sea
S. Santoro, National Research Council of Italy (CNR); S. Giardina, Ministry for the Environment, Land and Sea; M. Orrí, National Center for Chemical Substances - National Institute of Health; D. Romoli, Italian National Institute for Environmental Protection and Research;
Concerning the oil and gas offshore platform activities, the Italian Ministry of the Environment, Land and Sea has adopted a new approach to decide for the release/renewal of the authorisation to discharge the Produced Formation Water (PW), a by-product of both oil and gas extraction, into the sea. This approach aims at assessing more deeply the possible environmental impact of the additives used in hydrocarbon extraction activities. In this context, we present the application of the environmental risk assessment methodology, set out by REACH Regulation on chemicals, for some additives (e.g. Diethylene glycol) used in oil and gas platform activities. This approach allowed to determine specific concentration limits eligible for seawater discharge of these additives. By applying this methodology we compared the Predicted No-Effect Concentration (PNEC) with the predicted environmental concentration (PEC) related to the release of the substance in the seawater. The work already concluded on Diethylene glycol showed that the compound is considered for a concentration of 74 mg/l for constant/frequent release and 5900 mg/l for intermittent release. These limits have been included by the Ministry of Environment as a binding condition for granting the authorisation of discharge to the platform manager. Session: 3.12 Improvements in environmental exposure assessment: development and application of tools industry sectors, regulatory agencies and international boundaries. Authors: S. Santoro, National Research Council (CNR) - Instituto of Atmospheric Pollution Research Italian Ministry of the Environment, Land and Sea Silvia Giardina – Italian Ministry of the Environment, Land and Sea – General Directorate for environmental assessments and authorisations Maria Antonietta Orri – National Institute of Health - National Center for Chemical Substances Debora Romoli - Italian National Institute for Environmental Protection and Research.

TH233 Multidisciplinary approach for discussing the rice crop specific needs in Southern Europe in the view of the Plant Protection Products assessment: conclusions from an ad hoc workshop
A. Carone, Dow AgroSciences Italia srl; A. Whyte, Dow AgroSciences Ltd; A. Alix, Dow AgroSciences / Risk Management; G. Azimonti, ICPS International Centre for Pesticides and Health Risk Prevention; R. Cabella, INAIL - Dipartimento di Medicina, Epidemiologia, Igiene del Lavoro e Ambiente; G. Canha, Lusosem S.A.; C. Civitella, ICPS International Centre for Pesticides and Health Risk Prevention; M. Corvaro, Dow AgroSciences Ltd; N. Dalla Valle, Dow AgroSciences Italia srl; F. Dias, Cooperativa Agricola Montemor; E. Garcia, I. Gonzalez, Dow AgroSciences Ibérica, S.A.; M. Guarise, Dow AgroSciences Italia srl; P. Havens, Dow AgroSciences LLC; M. Luini, F. Marchetto, ICPS International Centre for Pesticides and Health Risk Prevention; G. Mereggalli, Dow AgroSciences Italia s.r.l. / Ecotoxicology; M. Osuna Ruiz, CIRES; C. Ritter, Waterborne Environmental, Italian Ministry of the Environment, Land and Sea – General Directorate for environmental assessments and authorisations Mari;
In Europe and in the context of Regulation (EC) 1107/2009 for placing into the market of plant protection products rice as a crop is an anomaly and has created several difficulties in its evaluation. For regulators, there is a need for comprehension of the unique agronomic practices, application techniques, water management and environmental concerns, both from an ecotoxicology and environmental fate perspective considering the majority of rice cultivated within the Europe is grown in paddy fields. This gap in knowledge caused issues in the evaluation of rice products as a representative use in the process of European authorization of new substances for plant protection products and raised questions on their suitability of environmental indicator species and risk assessments within the context necessary. Rice is a major crop in many Southern Zone Countries and the difficulties gaining an understanding of rice practices, compounded by uncertainty with changing regulatory requirements and a lack of transparency in evaluation procedures has hampered the process of active substances approval. Such a complex framework could dissolve active substance renewal by agrochemical manufactures or indeed inhibit innovation. In conjuction, an increase in weed resistance to plant protection products currently available has forced Member States to continually rely on Emergency Uses Permit year on year to support the rice growing community. Weed and pest tolerance to agrochemicals is increasing across Europe. As such, problems such as the lack of market tools available for weed and pest control. Rice farmers recognise the urgent need for active substances to be placed on the market with different modes of action to combat resistance and safeguard the production. The above mentioned topics have been deeply discussed among experts of different disciplines from the rice producing European Countries in an ad hoc workshop facilitated by Dow AgroSciences in July 2017. The outcome of the discussion highlighted the bottlenecks in multidisciplinary approach, with farmers, local networks, users and research institutes facilitating an environment to coordinate a strategy for implementation, with a Member State authority championing this venture through zonal steering groups. The main conclusions of the workshop will be presented and discussed in the poster.
The case study also demonstrates the combined applicability of experimental data, QSAR and read-across in the assessment of the aquatic toxicity of the individual constituents and impurities in order to derive appropriate PNECs for each assessment entity.

TH237
Canada’s Approach to Determining Causes of Impairment at Federal Contaminated Sites
M.H. Henning, D. Pelletier, Ramboîl EH; M.T. Sorensen, Ramboîl / Senior Science Advisor
Canada’s Federal Contaminated Sites Action Plan (FCSAP) was developed to reduce risks to human health and the environment from--and to reduce the financial liabilities associated with--federal contamination that had been performed since 1995. The new requirements have been applied for the first time in the 2017 Water Column Monitoring program. This holistic approach shows a significant improvement in the scientific outcomes of the monitoring, in a cost-efficient way. The surveys included the use of species from various trophic levels and the analysis of both chemical and biological parameters. Three regions were selected: Tampen, Southern Norwegian Sea and Egersundbanken (reference area) and in addition the near platform effect (Staflord A) was assessed. The study design included the use of a predictive discharge model (Dose-related Risk and Effect Assessment Model, DREAM). This model calculates the fate of the discharge in 4 dimensions (including time) to predict environmental concentrations, risk and effects. Biological and chemical data confirmed the accuracy of the study design and predicted effects. These three observation units were used to test the degree of uncertainty in both exposure and ecotoxicological higher tier effects evaluation. Among the potential applications, correlating dates and BBCH would help to:-- harmonize the application date selection to parameterize the application scheme implemented in the SWASH model, in order to predict pesticide’s loading in surface water due to drift, drainage and run-off;-- provide data to substantiate the geographic and temporal representativeness of higher tier ecotoxicological studies. Hence, to support the risk assessment process where a weight of evidence approach is envisaged.

TH238
Improving “man via the environment” exposure assessment for lead: a case study of in-use and recycled uses
S. Navis, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; F. Verdonck, ARCHE; K. De Brouwere, VITO NV / Health; L. Geerts, VITO NV; J. Chowdhury, International Lead Association / Senior Scientist
Environment; L. Allen, S. Binks, International Lead Association
Current chemical safety assessments for metals under REACH typically include a generic worst-case approach to lead risks to human populations resulting from exposure via the environment. As a result of comprehensive biological monitoring campaigns undertaken by European Member States in the past and supplemented modelling data, a large body of data is available on lead body burdens in the general European population (children and adults). However, little information is reported for blood lead in populations surrounding lead manufacturing facilities. Moreover, whereas lead in food and beverages is the primary expected source of exposure (with soil and dust also contributing to children’s exposure due to play habits), it is difficult to apportion the source of this lead exposure to specific uses. Under REACH authorization processes (as part of a socio-economic analysis), it becomes more important to estimate the contribution of a specific use and specific exposure pathways. Consequently, there is a need to better define the contribution of lead exposures resulting from battery manufacturing and recycling operations in the EU. This paper presents the development of a conceptual model to assess risk in humans indirectly exposed to lead via the environment using a tiered approach that utilizes the European Union System for the Evaluation of Substances (EUSES) and other advanced tools such as Matlab and Expo for risk assessment. As a first step, local site-specific and regional environmental exposure scenarios and assessments are updated. Next, lead specific empirical bioaccumulation and transfer factors are derived based on a comprehensive literature survey. These parameters are used to describe additional pathways missing in EUSES, such as deposition on crops and soil/dust ingestion. Such pathways have been demonstrated to be dominant sources of lead exposure in humans and thus included in a so-called EUSES V2. Based upon the results of this EUSES-like screening exercise, higher tier approaches are developed for selected exposure pathways and/or scenarios. Ultimately the results of the environmental exposure modeling have been used in a comparison of predicted blood lead levels with biomonitoring data in the process of risk characterization and documentation as needed for REACH authorization purposes

TH239
Validation of the industrial Simple Treat model for a site-specific setting
J.C. Otte, M. Alter, A. Boehm, H. Eipel, I. Lenche, S. Pawłowski, BASF SE
The multimedia model Simple Treat is applied in the chemical legislation in Europe for decades and recently also in other legislations around the globe. It evaluates the distribution and elimination of chemicals by sewage treatment plants (STPs) in a municipal environment. It has been shown that the specific settings of industrial STPs differ largely compared to the standard settings of the municipal model of Simple Treat in terms of inter alia biological oxygen demand, hydraulic retention time, suspended solids, dissolved organic carbon, etc. The multimedia model simulates the chemical fate in industrial STPs (uTreat, Straus et al. 2016, Chemosphere 159, 619-627) but failed to show site specific validation due to lack of appropriate data. Therefore, the iTreat model was parametrized to the specific parameters of an industrial STP at a specific site. Time series of measured elimination of 22 substances in the wastewater stream of this specific STP were gathered and compared to the calculated elimination of the iTreat model. The bioaccumulation of contaminants by aquatic species is a sensitive parameter when predicting the elimination rate with either model. In detail, substances with low biodegradation rate constants (e.g. the rate constant of 0.1 h⁻¹) in the dataset show far more realistic elimination rates in the parametrized iTreat model than for the non-parametrized iTreat or the two municipal models. Compared to the municipal model of Simple Treat 3.1, the parametrized iTreat showed up to two-fold higher elimination rates which reflect the measured elimination. The application of specific degradative rate constants (derived from biodegradation tests with adapted activated sludge of the respective site) for the site-specific model of iTreat will also be discussed in this poster contribution. Taken together, the validation exercise was successful and the parametrized iTreat model is applicable to other substances being produced at this site where measured data is not available.

TH241 A Bayesian approach to estimate biodynamic model parameters: bioaccumulation of PCB 153 by the freshwater crustacean Gammarus fossarum.
A. Ratier, Irstea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Hydrometeorological Institute; H. Budzinski, University of Bordeaux; P. Labadie, UMR CNRS EPEC Université Bordeaux / UMR 5805 EPEC; L. Peluhet, CNRS / UMR EPEC LPTC; N. Delorme, L. Garnero, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Irstea / UR MALY Laboratoire Ecotoxicologie; M.P. Babut, Irstea / Water

The bioaccumulation of PCBs in aquatic organisms is known to be an important route of bioaccumulation of contaminants. The elimination process includes excretion, metabolism and dilution by growth. To date, there are few models focusing on persistent organic contaminants. Furthermore, estimating models' parameters is generally done through a frequentist approach in two steps: first by estimating parameter(s) related to depuration and then estimating parameter(s) related to accumulation. The problem by doing this is that depuration during the accumulation phase is neglected, while this process occurs in the two phases. The aim of our study is to propose a Bayesian framework to estimate the parameters of a biodynamic model together by considering simultaneously accumulation and depuration data. The posterior distribution obtained for all parameter will enable a more accurate assessment uncertainties. The results are compared to the approach with the freshwater benthic invertebrate Gammarus fossarum exposed for 7 days to a sediment spiked with PCB153 and transferred to a clean media for 7 more days. The PCB153 concentrations in Gammarus fossarum increased from an initial concentration of 0.32 to 12.36 ng·g⁻¹ ww (wet weight) at the end of accumulation step. When gammarids were transferred into a clean media, the PCB153 concentration in organisms decreased to 6.41 ng·g⁻¹ ww at day 14. The bioaccumulation model assuming first-order kinetics was fitted to the data using Bayesian inference. The inference process quickly converged and thin posterior distributions were obtained for each parameter, meaning that data brought enough information to estimate precisely each parameter. The median model predictions and their 95% credibility intervals showed a good fit of the model to the data.

TH242 Bioaccumulation and biotransformation of Hexabromocyclododecane (HBCD) by the freshwater crustacean Gammarus fossarum: a Bayesian approach to estimate biodynamic model parameters.
A. Ratier, Irstea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Hydrometeorological Institute; H. Budzinski, University of Bordeaux; P. Labadie, UMR CNRS EPEC Université Bordeaux / UMR 5805 EPEC; L. Peluhet, CNRS / UMR EPEC LPTC; N. Delorme, L. Garnero, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Irstea / UR MALY Laboratoire Ecotoxicologie; M.P. Babut, Irstea / Water

Toxicokinetic models are used to describe how organisms bioaccumulate chemicals or other substances according to uptake and elimination processes. They provide a theoretical framework for understanding phenomena, testing hypotheses, and predicting some outputs of interest. In these models, the absorption process can result from dissolved or trophic routes. The elimination process includes excretion, biotransformation and dilution by growth. To date, models exist to describe the accumulation of persistent organic pollutants (i.e. chemicals that do not degrade in various aquatic organisms. However, taking into account biotransformation remains problematic despite its potential importance. It is a key process that can limit the bioaccumulation of parent compounds while generating potentially hazardous metabolites. It varies considerably among species and contaminants. The aim of our study is to propose a Bayesian framework to estimate the parameters of a biodynamic model taking into account biotransformation, by considering simultaneously accumulation and depuration data. We illustrate our approach with the freshwater benthic invertebrate Gammarus fossarum exposed to a sediment spiked with Hexabromocyclododecane (HBCD) for 9 days and transferred to a clean media for 9 days. HBCD is a brominated flame retardant which has been detected in various environmental media and has been shown toxic for aquatic life. Previous studies have shown an isomerization of HBCD from sediment (γ-HBCD) to fish (β-HBCD). The bioaccumulation model assuming first-order kinetics was fitted to the data using Bayesian inference. This poster will present the first results about this experiment. We will discuss about the posterior distributions obtained for each parameter and the fit of the model to the data.

TH243 Chemical Exposure Disparities by Demographic Traits in the US Population 1999-2014
V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; J. Colacino, University of Michigan / Department of Environmental Health Sciences; J. A. Vrijheid, University of Michigan

Identifying individuals or populations at high risk for adverse health outcomes due to chemical exposure requires understanding how chemical exposure patterns vary by inherent traits. Currently, we lack of comprehensive screening to study the thousands of chemicals populations are exposed to on a daily basis. The purpose of this study is to develop a systematic approach that quantifies chemical exposure disparities for a broad set of demographic factors (age, gender, race/ethnicity, PIR, and smoking status) by using generalized linear model while controlling for relevant confounders and covariates.

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Our findings show that race/ethnicity, gender, and socioeconomic status can be statistically significant predictors of chemical exposure. More specifically, parabens, which are chemicals used in personal care products (PCPs), and 2,4- and 2,5-Dichlorophenol, which can be a products of photo-degradation of triclosan, a common antibacterial and antifungal agent, were observed to elevated in African Americans when compared to White Americans. In addition, higher levels of parabens in women was found, while men had showed higher concentrations of N-N-Diethyl-meta-toluamide (DEET). This could possibly be from women using cosmetic PCPs more frequent and in larger amounts, and men using insect repellent slightly more frequently than women do. Finally, individuals of higher socioeconomic status had higher levels of benzophenone-3 (used in sunscreen products), parabens, and triclosan, which could possibly be explained by more accessibility to PCPs. In this study, we have identified inherent and demographic traits associated with elevated biomarker concentrations. We hypothesize that this is due to use patterns of consumer product, particularly PCPs. This could support research findings emphasizing the importance of near-field chemical exposures.

**TH244**

**Occupational exposure to flame retardants among Canadian e-waste dismantlers**

L.V. Nguyen, University of Toronto - Scarborough / Department of Physical and Environmental Sciences; V.H. Arrandale, Cancer Care Ontario; M.L. Diamond, University of Toronto / Department of Earth Sciences

The amount of e-waste produced globally is growing dramatically. National numbers suggest in PM10, PM2.5 and ultrafine particles across Canada increased seven times in the period of 2002-2012 from 10,250 to 71,300 tonnes/y. One hazard associated with e-waste dismantling is flame retardants (FRs) which are added to electronic and electrical products to meet flammability standards. Little is known about exposure of workers to FRs in e-waste dismantling facilities in high-income countries such as Canada. Here, we have undertaken the first study to report on concentrations of flame retardants detected FRs in indoor air in an e-waste dismantling facility in Southern Ontario, Canada, and to estimate occupational exposure of dismantlers at the facility to these FRs. Sampling was conducted daily over a total of five days in February 2017. Thirty-three dust samples were collected using vacuum cleaners and air samples were collected using polydimethylsiloxane (PDMS) passive air samplers (PDMS-PASs) co-deployed with active low-volume air samplers (LV- AAS). A Micro-Orifice Uniform Deposition impactor (MOUDI) was used to obtain particle size distribution of air samples. Post-deployment, samples were extracted and analysed for 12 target FRs, including novel brominated flame retardants (NFRs), polybrominated diphenyl ethers (PBDEs) and organophosphate esters (OPEs), using gas chromatography mass spectrometry (GC-MS). The most abundant FRs in air and dust samples were the novel brominated FRs, di(2-ethylhexyl) phthalate (DEHP) and di(2-ethylhexyl) sebacate (DEHS), accounting for ~70-98% of all target compounds. The median air concentrations of six PBDEs ranged from 1930 ng/m^3^ to 2900 ng/m^3^. Preliminary estimates made using air concentrations measured here suggest that the total daily inhalation intake of all 12 FRs was ~17 μg/day FRs among e-waste dismantlers. Results for the MOUDI samples showed that triphenylphosphate (TPPh) and other replacement FRs were much lower concentrations in indoor air than in the outdoor air. The levels of FRs in air collected from this Canadian e-waste recycling facility suggest opportunities for inhalation exposure to flame retardants among e-waste dismantlers in Southern Ontario, Canada.

**TH245**

**Global approaches to environmetal exposure assessment of e-wastes**

D. Purchase, Middlesex University / Department of Natural Sciences, Faulty of Science and Technology; L. Bisschop, Erasmus University Rotterdam / Department of Criminology; C. Ekberg, Chalmers University of Technology / Division of Energy and Materials, Department of Chemical and Chemical Engineering; P. Fedotov, Russian Academy of Sciences / Vernadski Institute; H. Garlich, Middlesex University; N. Kandle, Ain Shams University / Department of Chemistry, Faculty of Women; R. Luque, University of Córdoba / Chemistry; O. Popoola, Yaba College of Technology / Department of Chemical Science; H. Ruedel, Fraunhofer IME / Department of Chemistry, Faculty of Women; R. Luque, University of Córdoba / Chemistry; O. Popoola, Yaba College of Technology / Department of Chemical Science; H. Ruedel, Fraunhofer IME / Institute for Molecular Biology and Applied Ecology / Department of Environmental Monitoring; A. Serpe, University of Cagliari / Department of Environmental and Geographic Architecture; K. Surati, Sardar Patel University / Department of Chemistry; B.P. Wilson, Aalto University / Department of Chemical and Metallurgical Engineering.

Solid or end-of-life electrical and electronic equipment waste streams continue to grow exponentially, creating a worldwide pollution problem. E-waste comprises a heterogeneous mix of hazardous and non-hazardous metals, metalloids, glass, plastic, flame retardants and other volatile substances (e.g. lead, silver, palladium, platinum and indium). In developed countries, e-waste management is resolved using two major strategies: either by internal recycling/disposal or via exportation to developing nations. For developing countries, the management of e-waste is complicated by illegal waste shipments and further exacerbated by weak environmental regulations coupled to inadequate technology and organizational structures. Rudimentary methods such as dismantling, melting, burning and burning are often used by the informal sector to recover valuable materials from different e-waste components. These unofficial recycling practices contribute to the release of toxic metals and persistent pollutants that affect both the environment and human health. As a result, e-waste issues are complex, multi-faceted and can only be successfully tackled via a multidisciplinary, trans-boundary approach that involves all stakeholders that include amongst others: manufacturers, scientists, economists, policy makers, waste professionals and consumers. The e-waste project [“The Environmental and Health Challenges of E-waste and its Management: an Emerging 21st Century Global Concern” (#2014-031-3-600)], supported by the International Union of Pure and Applied Chemistry (IUPAC), brings together multidisciplinary global experts to explore different aspects of the worldwide challenge: chemical analysis of contaminants, policy, and governance, environmental and health impacts, development and advance in treatment technologies including e-waste valorisation. This presentation makes use of studies from the world to highlight the following: i) discrepancies in the provision and enforcement of regulations between developed and emerging countries; ii) complexity in the analysis of e-waste contaminants in environmental and biological samples; and iii) lack of harmonisation of tools or indices to assess risk in environment and health, particularly in soil. It is proposed that a harmonised approach should be taken to use appropriate speciation analysis (e.g. to assess bioavailable or bioaccessible fractions) to evaluate e-waste contaminant risk.

**TH246**

**Droplets deposition pattern from a prototype of a fixed spraying system in a sloping vineyard**

S. Özyürek, Italian National Research Council; G. Innererbe, A. Schmid, C. Roschat, Laimburg Research Centre; D. Loddo, University of Padova / DAFNAE; M. Venturelli, Edmundo Mach Foundation; L. Laimburg Research Centre; D. Loddo, University of Padova / DAFNAE; M. Venturelli, Edmundo Mach Foundation.

In Italy quality vines are sometimes grown in small fields on steep slopes where spray-gun application of pesticides is used, a technique that is very costly and labor intensive. A possible alternative is the use of a fixed spraying system, and first researches are in progress. A fixed spraying system prototype was built in a vineyard at Laimburg Research Centre and a trial was performed with the aim of measuring the deposition pattern of droplets on the vine and between rows with water sensitive papers, also in comparison with a precise low-drift air-spray blaster. Results show that a fixed spraying system has the potential to apply plant protection products without generating drift problems, with a performance similar to a low-drift sprayer, becoming an opportunity for vineyards on very steep slopes.

**TH247**

**Sensitive Arsenic Speciation by Capillary Electrophoresis Using UV Absorbance Detection with On-Line Sample Preconcentration Techniques**

H. Lee, J. Kwon, Seoul National University; D. Chung, Seoul National University / Chemistry

The World Health Organization (WHO) guideline states that the total arsenic concentration in drinking water must not exceed 10 ppb. However, arsenic toxicity varies significantly, with inorganic arsenic species being more toxic than organic species. Arsenic speciation is therefore important for the evaluation of health risks from arsenic-contaminated drinking water. Capillary electrophoresis (CE) provides the necessary high performance separation for the determination of arsenic species. In this study we investigated the potential of CE to act as a screening tool and a preparatory step for liquid chromatography. A capillary electrophoresis beach, commercial precolumn and on-line sample preconcentration techniques such as volume air sample stacking with electroosmotic flow pump, field amplified sample injection (FASI), transient isochromatography (iTTP), electrokinetic supercharging (EKS) combining FASI and iTTP, and counter flow (CF)-EKS were therefore investigated. With CE-EKS using phosphate and NaOH buffers, 3.2-aminomethylxilic acid was successfully preconcentrated from 6,300 to 45,000-fold, accounting for ~0.3 ppb As. For a spring water sample spiked with the four arsenic species, LODs of 2–9 ppb As were obtained, which are lower than the WHO guideline of 10 ppb total As.

**TH248**

**Determination of background levels of free cyanides in surface waters**


Natural background concentrations of cyanide can originate from the degradation of proteins, amino acids, carbohydrates, cytosoles, cyanides, cytosines in human health. As a result, e-waste issues are complex, multi-faceted and can only be successfully tackled via a multidisciplinary, trans-boundary approach that involves all stakeholders that include amongst others: manufacturers, scientists, economists, policy makers, waste professionals and consumers. The e-waste project [“The Environmental and Health Challenges of E-waste and its Management: an Emerging 21st Century Global Concern” (#2014-031-3-600)], supported by the International Union of Pure and Applied Chemistry (IUPAC), brings together multidisciplinary global experts to explore different aspects of the worldwide challenge: chemical analysis of contaminants, policy and governance, environmental and health impacts, development and advance in treatment technologies including e-waste valorisation. This presentation makes use of studies from the world to highlight the following: i) discrepancies in the provision and enforcement of regulations between developed and emerging countries; ii) complexity in the analysis of e-waste contaminants in environmental and biological samples; and iii) lack of harmonisation of tools or indices to assess risk in environment and health, particularly in soil. It is proposed that a harmonised approach should be taken to use appropriate speciation analysis (e.g. to assess bioavailable or bioaccessible fractions) to evaluate e-waste contaminant risk.
µg/L. Here an existing continuous flow analysis (CFA) method was selected using a system with a special cuvette installation allowing a higher sensitivity. The protocol was validated and accredited according to standard ISO/IEC 17025. With this system an LOQ of 0.15 µg/L can be reached under optimal conditions while an LOQ of about 0.3 µg/L is achieved during routine operation. Previous to field testing it was verified that samples can be stabilized for at least 24 h by adjusting the pH of samples between 12 and storing them in the dark at 4°C. Samples spiked with low concentrations of a cyanide standard were used as positive controls. The field validation results were satisfactory, confirming that the protocol is fit for purpose. Finally, samples from several sites of a small stream with low anthropogenic influences (River Lenne) were taken and analyzed. Free cyanide concentrations of up to 0.4 µg/L were detected. There were significant differences in free cyanide concentrations between sites, with levels mainly below the limit of detection (LOD, 1/3 of the LOQ), and downstream sampling points where free cyanide concentrations were at least 50% higher, possibly due to degraded plant biomass in the water. This first measurements revealed that background concentrations of free cyanide in the tested surface waters can be below the proposed EQS of 0.5 µg/L.

However, the analysis of further parameters (e.g. geographical regions, seasonality) is necessary to create a reliable database on the range of free cyanide background levels as basis for EQS implementation.

TH249
Application of equilibrium and kinetic passive sampling method to quantify integrative chemical profile in a small river and the outflow of WTW Yohond, H. H. K., with workshop: K. Schefler/Europe/Institute for Safeguard Groundwater Meyer, E. Finufrocken, H. Beck, Saarland University; K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics

Monitoring water quality is challenging as most of organic contaminants present at trace levels and chemical profile is fluctuating. Current legislative requirement of water monitoring in Europe is established e.g. Water Framework Directive 2000/60/EC. The protocol consists in membrane selection, necessary to protect micropollutants from photolysis and to develop the optimal sample preparation allowing the calculation of diffusion coefficients according to Fick’s second law. Diffusion coefficients obtained with this method are congruent with those found in literature. TH250
Improvement of relationship between water pesticide contamination and land used at a large scale using the Polar Organic Chemical Integrative Sampler (POCIS), as an equivalent passive sampler, were deployed without the application of performance reference compounds. From the concentration ratio from two PDMS sheets, true in situ concentration was determined. In parallel, two types of polar organic chemical integrative sampler (POCIS) were selected as a kinetic passive sampler. The one is typical POCIS with Oasis HLB® sandwiched between polyethersulfone membranes and the other is made of PDMS sheets, true in situ concentration over the full sampling period. PDMs sheets with two different thicknesses (76 and 209 µm), as an equivalent passive sampler, were deployed without the application of performance reference compounds. From the concentration ratio from two PDMS sheets, true in situ concentration was determined. 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The sampling of micropollutants is a challenge due to their weak concentrations and their temporal variability. These last years, passive samplers have been developed with the advantage to improve the temporal representativeness by measuring “Time Weighted Average (TWA) concentrations”. For the passive sampling of moderately hydrophobic organic contaminants the Polar Organic Chemical Integrative Sampler (POCIS) is the most used and investigated device to date. However, POCIS has some drawbacks since sampling rates are highly affected by water flow velocity, leading to possible bias for TWA concentration estimates. An alternative to POCIS is the Diffusive Gradient in Thin-film technique for organic contaminants (o-DGT). Unlike POCIS, the presence of a diffusive gel may reduce the influence of the water boundary layer, and then hydrodynamic effects on sampling rates. Our objective is to develop the o-DGT for a reliable sampling of a wide range of 60 pesticides, 20 hormones and 38 pharmaceuticals in water selected to cover a wide range of physico-chemical properties (hydrophobicity, ionisability, size, functional groups, ...). For that purpose, we first chose the best diffusive gel (e.g. agarose or polyacrylamide) by determining diffusion coefficients for all the compounds, with the comparison of 2 methods: slice stacking and diffusion cell. The slice stacking consists in contaminant diffusion from 1 spiked gel to 5 clear gels in let in contact for 30 minutes. The concentration in each gel disk was determined over the time, allowing the calculation of diffusion coefficients according to Fick’s second law. Diffusion coefficients obtained with this method are congruent with those found in literature. Thus obtained with the diffusion cell method are similar than those obtained by slice stacking except for ionic compounds, which also exhibited lower affinity with gels than water, in comparison to neutral compounds. The second step consisted in membrane selection, necessary to protect diffusive gel, and that needs to exhibit the lowest possible compounds retention. Three types of membrane (cellulose, polyethersulfone and nylon) were tested with different pore sizes (0.45 an 0.8 µm). Finally, to estimate the sampling rates, and to validate diffusion coefficients, a calibration experiment with micropollutants at environmental concentrations was conducted.

TH252
Development and calibration of o-DGT for pesticides, hormones and pharmaceuticals
B. Bonnaud, J. Rebillard, A. Schaeffer, RWTH Aachen University / Institute for Environmental Biology and Chemodynamics

The sampling of micropollutants is a challenge due to their weak concentrations and their temporal variability. These last years, passive samplers have been developed with the advantage to improve the temporal representativeness by measuring “Time Weighted Average (TWA) concentrations”. For the passive sampling of moderately hydrophobic organic contaminants the Polar Organic Chemical Integrative Sampler (POCIS) is the most used and investigated device to date. However, POCIS has some drawbacks since sampling rates are highly affected by water flow velocity, leading to possible bias for TWA concentration estimates. An alternative to POCIS is the Diffusive Gradient in Thin-film technique for organic contaminants (o-DGT). Unlike POCIS, the presence of a diffusive gel may reduce the influence of the water boundary layer, and then hydrodynamic effects on sampling rates. Our objective is to develop the o-DGT for a reliable sampling of a wide range of 60 pesticides, 20 hormones and 38 pharmaceuticals in water selected to cover a wide range of physico-chemical properties (hydrophobicity, ionisability, size, functional groups, ...). For that purpose, we first chose the best diffusive gel (e.g. agarose or polyacrylamide) by determining diffusion coefficients for all the compounds, with the comparison of 2 methods: slice stacking and diffusion cell. The slice stacking consists in contaminant diffusion from 1 spiked gel to 5 clear gels in let in contact for 30 minutes. The concentration in each gel disk was determined over the time, allowing the calculation of diffusion coefficients according to Fick’s second law. Diffusion coefficients obtained with this method are congruent with those found in literature. Thus obtained with the diffusion cell method are similar than those obtained by slice stacking except for ionic compounds, which also exhibited lower affinity with gels than water, in comparison to neutral compounds. The second step consisted in membrane selection, necessary to protect diffusive gel, and that needs to exhibit the lowest possible compounds retention. Three types of membrane (cellulose, polyethersulfone and nylon) were tested with different pore sizes (0.45 an 0.8 µm). Finally, to estimate the sampling rates, and to validate diffusion coefficients, a calibration experiment with micropollutants at environmental concentrations was conducted.
application group. Although both basalpetal movement (downward from leaf application site) via plhemo and acropetal movement (upward from both leaf and root application sites) via xylem were observed, results indicate the movement of radioactive residues is much faster through xylem. Select tissue samples were extracted and analyzed by HPLC-RAM, which shows that the majority of translocated radioactive residues by plhemo was metabolites of the active ingredient. A comparison of quantitation of translocation during a conventional plant mass flow experiment can provide valuable information to better assess the potential effects of plant protection products on pollinating insects.

TH253
An Examination of Microbial Biomass in Sediments and the Impact of Seasonal Variation
K. Malekani, Smithers Viscient / Environmental Fate and Metabolism; S.P. McLaughlin, Smithers Viscient / Department of Environmental Fate; K. Campbell, Smithers Viscient / Environmental Fate
Metabolism
Microbial biomass is an important measure of the health and viability of a sediment just as it is for soils. It is also a parameter used to assess viability of the ecosystem. Seasonal changes in the concentration of organic matter in sediments is typically determined by fumigation/extraction procedure prior to test initiation (post-handling/pretreatment), near test initiation and near test termination. The current presentation will focus on the initial microbial biomass as an indication of health and viability of sediments at the time of their collection. A collection of initial sediment microbial biomass values has been summarized and presented based on their time of collection during the year. An example of the data collected is the study conducted on Honey bees (Apis mellifera L.) during a conventional plant exposure study (Taunton) and one sandy sediment (Weweantic) collected during all four seasons, over a two-year period produced microbial biomass values (expressed as % OC) shown below. 2016 Taunton Weweantic 2017 Taunton Weweantic Winter 0.47 0.11 Winter 0.81 0.05 Spring 0.32 1.1 Spring 0.76 0.82 Summer 0.63 0.28 Summer 0.51 0.41 Full 0.40 0.22 Fall 0.60 0.71 late summer Additional biomass results will be presented, discussed and correlated to other sediment parameters, including texture, pH, and % OC. Conclusions from several sediments used in recent years will be extrapolated from trends in the data set concerning seasonality, environmental conditions and sediment characteristics.

TH254
Use of scanning electron microscope (SEM) in evaluation of hypopharyngeal glands development in Honey bees (Apis mellifera L.)
A. Drzewiecka, M. Napora-Rutkowski, Institute of Industrial Organic Chemistry Branch Pszczyna / Department of Toxicological Studies; E. Kulec-Płoszycka, P. Parma, Institute of Industrial Organic Chemistry Branch Pszczyna / Department of Toxicological Studies; N. Lemańska, Institute of Industrial Organic Chemistry Branch Pszczyna / Department of Toxicological Studies; M. Vannoni, University of Saskatchewan / Department of Veterinary and Biomedical Sciences; M. Kirby, University of Saskatchewan / Department of Veterinary and Biomedical Sciences; E. Kulec-Płoszycka, P. Parma, Institute of Industrial Organic Chemistry Branch Pszczyna / Department of Toxicological Studies; N. Lemańska, Institute of Industrial Organic Chemistry Branch Pszczyna / Department of Toxicological Studies; M. Vannoni, University of Saskatchewan / Department of Veterinary and Biomedical Sciences
The hypopharyngeal glands (HPG) of Honeybees consist of many acini connected with a collecting duct, arranged in the form of long paired cords lying on both sides of the head. They played important role in maintaining healthy colonies i.e. through production of ‘milk’ containing proteinic substances to feed larvae and queen. The aim of this study was to check the possibility of using scanning electron microscope (SEM) to evaluate the development of hypopharyngeal glands of bees, considering reliability, work-, time-consuming and cost-effectiveness of the method, including collecting of material. The study was conducted on Honey bees (Apis mellifera L.) subjected to chronic toxicity studies performed according to the EFSA guidelines (EFSA Journal 2013;11(7):3295). Animals were treated with four methods, including collecting of material. The study was conducted on Honey bees (Apis mellifera L.) from the studies indicate that SEM can be useful tool for evaluation of and increases of acini and their number per 1 mm². Next specimens were fixed in 2,5 % formaldehyde in phosphate buffer, then postfixed in 1% OsO₄ and dehydrated with grades series of ethyl alcohol followed by acetone. Next specimens were critical-dried (CPDS, Critical Point Drying System), then coated with gold particles before observation in JEOL JSM-6390LV. The images and linear measurements (small and big axis of symmetry) from ten acini as well as number of acini per 1 mm² were taken from each samples. The analysis of the results showed decreases and increases of acini and their number per 1 mm², depending on the test item, however, these differences were not always statistically significant. It turns-out, that images were very valuable, allowing visual comparison of acini. Data obtained from the studies indicate that SEM can be useful tool for evaluation of hypopharyngeal glands development of Honey bees.

TH255
Comparison of International Quality Assurance and Quality Control Standards for High Resolution Mass Spectrometry Dioxin Analysis
D. Thal, E. Ogburn, Environmental Standards Inc; R. Vitale, Environmental Standards; D. Bly, Environmental Standards Inc.
The analysis of polychlorinated dibeno-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs) in environmental media, foods and tissues by high resolution gas chromatography-high resolution mass spectrometry (HRMS) is frequently used as the reference methodology against which other candidate analytical approaches are compared. Official methods for this technology, e.g. US-EPA methods followed protocol or methods that were technically standardized for recovery correction have been established in the EU, the USA, and other nations for decades and international standards for such methods have been established by ISO (Standards 13914 and 18073, for example). To identify achievable best practices and to understand differences in precision, accuracy and qualitative certainty for data produced from wide-ranging sources, an examination of the requirements of these methods was conducted. A review identifying critical differences and areas of agreement with regard to qualitative criteria, precision and accuracy will be presented, with perspectives on the impact differences may have on data uses by researchers conducting analyses under different protocols.

TH256
New Mass Spectrometry Techniques for the Measurement of Persistent Organic Pollutants
P.D. Jones, University of Saskatchewan / School of Environment and Sustainability; J. Grex, University of Saskatchewan / Department of Veterinary and Biomedical Sciences; J. Giesy, University of Saskatchewan / Department of Veterinary and Biomedical Sciences; M. Bower, University of Saskatchewan / Department of Veterinary and Biomedical Sciences
Recent development of new mass spectrometry techniques and instrumentation has increased the amount and quality of analytical information that can be obtained from samples. In particular, dramatic increases in mass resolution have made possible unequivocal identification of contaminants even in complex mixtures and matrices. In the area of POPs analyses of PCDD/Fs and PCBs are of concern due to small concentrations that need to be quantified and the presence of a wide range of congeners that do not coelute and potentially interfere. Use of a GC/OrbiTrap system brings levels of mass resolution not previously available for analysis of POPs by GC chromatography coupled with ultra-high resolution mass spectrometry (GC-UHRRMS). Here we report use of GC-UHRRMS for identification and quantification of PCDD/Fs and PCBs. The methods developed are based on standard US-EPA methods (Methods 1613 and 1660) but are enhanced by use of new capabilities provided by image current detection and high mass resolution (>100,000 FWHM). Robustness of the GC/Orbi REF/DAs were demonstrated by excellent calibration characteristics and ability to detect all 2,3,7,8-substituted congeners even in an extract of used motor oil. Reanalysis of fish tissues previously analyzed by a magnetic sector instrument demonstrate accurate of estimations and quantifications and provide validation of the method. Analyses were also conducted to determine the potential for a ‘multiplex’ analysis of various POPs where the resolving power (>120,000 FWHM) of the MS system was able to eliminate potential interferences from a variety of ‘non-target’ organochlorines. These multiplexed analyses significantly reduce the time and cost of sample extract preparation and clean-up. In addition, the relatively simple auto-tuning and mass calibration algorithms available for the advanced mass spectrometry systems greatly simplify these otherwise challenging analyses.

TH257
Influence of water temperature and salinity on impact of Hazardous and Noxious Substances (HNS) in the marine environment
M. Bower, D. Doran, M. Racz, M. Bower, C. Sheahan, E. Ogburn, Cefas
It is recognised that Hazardous and Noxious Substances (HNS) transported at sea present a broad range of potential marine spill scenarios due to wide range of fate and effects of the many types transported in bulk through national and international waters. To improve preparedness of response and to provide better advice during marine incidents there is a need to improve our knowledge of the marine hazards/risks associated with the highest priority chemicals. Harbours and ports are typically located in transitional and coastal waters and ship traffic is more concentrated around these areas and so potential collisions are more likely. These areas are characterised by a range of salinity from 10 - 20 ppt within estuaries up to 34 ppt in coastal and offshore waters. Similarly, seawater temperatures vary significantly with seasonal and spatial variations. New studies were performed to investigate the toxicity of HNS associated with different salinities (from 20 to 30 ppt) and at temperatures (10 - 25°C). Different chemicals were chosen for the tests. Aniline and zinc sulphate were chosen as they are high priority HNS Chemicals due to their relatively frequent transport in bulk quantities. Additionally, benzalkonium chloride was a surfactant and bisphenol A (a disinfectant sodium hypochlorite were also investigated as they are transported in moderate quantities, ranging sources, an examination of the requirements of these methods was conducted. A review identifying critical differences and areas of agreement with regard to qualitative criteria, precision and accuracy will be presented, with perspectives on the impact differences may have on data uses by researchers conducting analyses under different protocols.

TH258
Standard for High Resolution Mass Spectrometry Dioxin Analysis
D. Thal, E. Ogburn, Environmental Standards Inc; R. Vitale, Environmental Standards; D. Bly, Environmental Standards Inc.
The analysis of polychlorinated dibeno-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs) in environmental media, foods and tissues by high resolution gas chromatography-high resolution mass spectrometry (HRMS) is frequently used as the reference methodology against which other candidate analytical approaches are compared. Official methods for this technology, e.g. US-EPA methods followed protocol or methods that were technically standardized for recovery correction have been established in the EU, the USA, and other nations for decades and international standards for such methods have been established by ISO (Standards 13914 and 18073, for example). To identify achievable best practices and to understand differences in precision, accuracy and qualitative certainty for data produced from wide-ranging sources, an examination of the requirements of these methods was conducted. A review identifying critical differences and areas of agreement with regard to qualitative criteria, precision and accuracy will be presented, with perspectives on the impact differences may have on data uses by researchers conducting analyses under different protocols.
marine traffic and potentially greater risk of marine incidents.

**TH258 Using Correlations of Biological Toxicity Equivalent Quotients and Toxicity Equivalent Quotients to Derive Threshold Values for Dioxin-Like Compounds in Sediment**

J.D. Dietz and R.W. Aachen University / Department of Ecosystem Analysis; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; C. Gembé, Institute for Environmental Research, Aachen University / Department of Ecosystem Analysis; S. Buchinger, Federal Institute of Hydrology / Department G Biochemistry and Ecotoxicology; G. Reifferscheid, German Federal Institute of Hydrology; H. Hendriks, R.W. Aachen University / Institute for Environmental Research, Sediments can act as a sink and source of pollution in aquatic environments, particularly with respect to persistent organic pollutants (POPs) which bind to sediments and then can be released into the aquatic environment if, and when, the sediments are disturbed (e.g., dredging, floods, storm events). Among POPs, dioxin-like compounds (DLCs), which consist of a variety of contaminants that share similar structures and can bind to the arylhydrocarbon receptor (AhR) in cells, are of particular concern. In addition to chemical analyses, which are often expensive and unnecessary if the contamination is low or below threshold concentrations, measurement of the induction of ethoxyresorufin-O-deethylase (EROD) activity using the rat hepatoma cell line (H4IIIE) has been identified as a potential bioanalytical screening tool for the presence of DLCs in the environment. In the presented project, the bioanalytical component involved the use of a 96-well plate-reader–based assay to measure EROD induction with the rat hepatoma cell line H4IIIE. The micro-EROD assay can be used to determine the cytotoxicity of p450 subfamily 1a (CYP1A)-inducing potential of a variety of substances, including extracts of sediment samples. For this project, micro-EROD assays and chemical analyses were performed on extracts of 22 sediment samples collected from waterbodies in Germany. We investigated the correlation of biological toxicity equivalent quotients (BEQs) determined from H4IIIE micro-EROD to toxicity equivalent quotients (TEQ) determined from chemical analysis of the sediment extracts for PCDD/Fs and DL-PCBs. Correlation analysis indicated strong significant relationships between BEQs and TEQs for PCDD/F (r²=0.940, p<0.001) and DL-PCBs (r²=0.924, p<0.001). From these correlations, threshold values can be established and the assay used as a pre-screening tool to identify samples that would require additional chemical analyses.

**TH259 Measuring bioconcentration of cationic surfactants in fish**

A. Homberg, C.L. Chen, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES); J.M. Armitage, University of Toronto - Scarborough / Physical and Environmental Sciences; J.A. Aro, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; S. Droge, University of Amsterdam/IBED Institute / IBED Institute. Measuring the bioaccumulation of cationic surfactants in fish is challenging. Their disposition in water depends on both pH and alkalinity. Many cationic surfactants have a tendency to sorb extensively to surfaces, making it difficult to generate and maintain constant concentrations in aquatic water. They may also sorb extensively to the surface of fish, making it difficult to separate internal exposure from external exposure. They display a partitioning behaviour that is similar to biomolecules, making it challenging to separate them from major matrix components in fish tissue. They can also be toxic to fish, which constrains the concentrations that fish can be exposed to. We are currently working to define the cationic surfactant property space that is amenable to measurement of bioconcentration factors in fish. We will exploit this property space to measure the bioaccumulation behaviour of a range of cationic surfactants. These data will be used to evaluate the BIONIC model, a mechanistically based model employing in vitro assay derived key input parameters (membrane-water partition coefficients and intrinsic hepatic clearance). The BIONIC model can in turn be used to estimate bioaccumulation of cationic surfactants in the property space that is not amenable to measurement. Our first experiments are conducted with a sodium dodecyl sulfate (SDS), a primary, secondary, tertiary and quaternary amine with chain length from C9 to C16. The test chemical mixture is infused continuously into the water inflow of a flow-through aquarium using a syringe pump. To determine the concentrations of the test chemicals in aquarium water, 400 µL of aqueous water is transferred with an auto-pipette to a vial containing 600 µL of methanol, and this mixture is analysed with GC/MS/MS. This method allows measurement at the high ng/mL concentration range with a precision of 2.3%. Concentrations in the aquarium were maintained at a constant level for more than a week, whereby the ratio measured/normal decreases with chain length. To determine the concentrations in fish tissue, methanol extracts are cleaned up on a weak cationic exchange SPE column followed by large-volume injection. This method allows quantification in the low ng/g range. The results of the first bioconcentration experiments will be presented.

**TH260 Acetylcholinesterase inhibition: a comparison of available methods for determination of acetylcholinesterase in muscle tissue of Limanda limanda.**

J. Użyck, Centre for Environment, Fisheries and Aquaculture Science (Cefas) / Environmental and Animal Health. Acetylcholinesterase inhibition (AChE) has been used as a biomarker of the effects of organophosphate and carbamate compounds. AChE is present in most animals and is responsible for the rapid hydrolytic degradation of the neurotransmitter acetylcholine (ACh) into choline and acetic acid. The inhibition of AChE is to regulate the nervous transmission by reducing the concentration of ACh. When AChE is inactivated by an organophosphorus or carbamate ester, the enzyme is no longer able to hydrolyse ACh and the concentration of ACh remains high. Continuous stimulation of the muscle or nerve then occurs, resulting in tetany and eventually paralysis and death. The ICES/IOC International workshop on Biological Effects of Contaminants, that took place in Bremerhaven, Germany during March 1990, provided on opportunity to test AChE inhibition as an index of marine contamination. An official ICES Technique in Marine Environmental Sciences (TIMES No.22 Biological effects of contaminants: Cholinesterase inhibition by organophosphate and carbamate compounds) is available and recommended for contaminant monitoring programmes in the marine environment. This method was published to improve and standardise the comparability between results from different laboratories and/or countries. However, the method has not been updated since 1998 and does not provide enough details on different marine species, preparation and handling of samples or storage conditions. The search continues for new monitoring tools, improvement and harmonisation of existing methods, which may be used as specific markers for contaminant effects on the safety of marine activities. For this purpose, scientific evidence of the suitability the marine environment can be applied differently. Then, to be marketed, scientific evidence of the suitability the marine environment should be obtained on a precise, consistent and comparable basis across the national and international laboratories and therefore provide a real evaluation of the status of the marine environment.

**TH261 Environmental emission to surface water for analogous exposure path. A reflection on the matter for biocides, human and veterinary medicines.**

A. Haro-Castuera, R. Carapeto García, Spanish Medicines Agency / Veterinary medicines; G. Cortés Ruiz, C. Rubio Montejano, Spanish Medicines Agency / Department of Veterinary Medicines. Our interest is happened for one active substance the chain of events affecting the environment follows its path. But how we study them depends upon the approach, dictated by legislative frames, subsequent guidance and, eventually, inertia and tradition. One remarkable example is the case of insecticides. While sharing the same active substance, different products authorized under different regulation can be applied differently. Then, to be marketed, scientific evidence of the suitability the marine environment share some principles making emphasis in different areas. Here, we will review emission paths and key risk elements as a thought starter pursuing harmonizing approaches and resource sharing between assessment schemes.

**TH262 Hazard and exposure assessment of chemical mixtures: steps towards increasing the realism of chemical risk assessment (P)**

**TH263 Using microarthropod community assays in metal mixture testing**

J. Renaud, CFE - Centre for Functional Ecology; T. Natal da Luz, University of Coimbra / Department of Life Sciences, University of Coimbra; S. Siciliano, University of Saskatchewan / Department of Soil Science; J. Sousa, University of Coimbra / Department of Life Sciences. Due to anthropogenic activities metal contaminated sites are a constant environmental concern and because of the persistence of these metal elements, will continue to be a pressing issue for many years to come. In terms of legislation and environmental risk assessment, much effort has been undertaken to understand the effects of metals and, more recently, the effects of metal mixtures. However, most legislation still focuses on single metal elements, disregarding mixtures. Similarly, research has been predominantly focused on single metals while mixture studies have mostly focused on binary and tertiary mixtures to determine metal interactions and how they affect hazardous and non-hazardous species. For this reason, there is a need for an addition which is the most commonly accepted model and that considered in legislation. These studies provide valuable information on the metal mixtures but are performed with few standard test species and use mixture ratios optimized for the goal of modelling mixture interactions, which many times lack environmental relevance. In this presentation we take a different approach and test three complex five element metal mixture ratios (Pb, Cu, Ni, Zn, Co) using a natural soil microarthropod community. These metal mixture ratios were selected based on environmental and legislative relevancy, two ratios...
produced from guideline values (Canadian soil quality guideline and EU REACH PNEC values) and a ratio based on the average concentrations in a contaminated site (Sudbury) for each metal. Each mixture was tested with 11 doses in toxic units estimated from Folsomia candida reproduction EC50 for each metal in the mixture. The community results from this experiment were transformed to similarity matrices using the Bray-Curtis coefficient and used to calculate dose response curves. This approach assumes that community changes are promoted by increasing metal contamination. These community dose response curves allowed the estimation of microarthropod community EC values, which provide valuable insight on the adequacy of current guideline values and in developing site-specific risk assessments and remedial goals with community endpoints. Produced EC values from this simplified community experiment are currently under validation in a terrestrial model ecosystem experiment, for these same mixtures.

TH264
Assessment of the toxic interaction of lanthanides on aquatic organisms
A. Romero, Université de Lorraine / LIEC, CNRS, UMR 7360, Université de Lorraine, Campus Bridoux, Bâtiment IBISE, 8 rue du General Delestraint, 57070, Metz, France; E. Joonas, M. Muna, National Institute of Chemical Physics and Biological Physics; D. A. Vignati, CNRS / LIEC UMR7360, L. Giamburini, Université de Lorraine, CNRS UMR 7360 / LIEC, CNRS

The relevance of lanthanides (LNs), in agricultural, industrial and, especially in high-tech applications has increased in the last decades. As consequence, more LNs are expected to enter into the environment and accumulate in the ecosystem. Although no great accumulations have so far been recorded, alterations in the LNs natural cycle have been observed, as the accumulation of LNs toxicity focuses on the effect of single elements, however they are commonly found as a group in nature. LNs are expected to have cumulative toxic effects on organisms, owing to their similar chemical properties, but studies as mixtures, more representative of real scenarios, are required to support this hypothesis. In this research, we evaluated the toxic interactions of binary and ternary mixtures of cerium, lanthanum and neodymium in the green alga Chlorococcum capsulatum and the invertebrate Brachionus calyciflorus, and identified the potential toxic elements which were observed only in five; and the inhibitory LN effects were consistently concentration-dependent only for A. fischeri, R. subcapitata and B. calyciflorus. Bioavailable LN concentrations significantly decreased during all tests and the major decline took place at the beginning of the tests, but the extent of the decrease varied across test media. Thermodynamic speciation calculation highlighted important differences: in distilled water and 1 % NaCl, LNs were predicted to occur mainly as free ions; in more complex media, LNs appeared as free forms and with complexes with both cations and anions; these latter metal species lowered with the decrease in the ionic radii, and, in detriment of these complexes, species with LN(OH)4- and LN(OH)3- groups increased. The two multi-toxicity approaches used in this study (concentration addition and toxic unit calculation) showed more than additive effect for the mixtures to the bacterium A. fischeri and the algae R. subcapitata; whereas less than additive toxicity was instead observed for the rotifer B. calyciflorus.

TH265
Prediction of the chemical and biological effects of tertiary metal mixture (Ni, Cu, Cd) to aquatic plant, Lemma gibba under different dissolved organic carbon concentrations
S. Martinez, CONICET PRIET UNILYU; Y. Gopalapillai, Environment and Climate Change Canada; M. Saen, PRIET CONICET, National University of Luján; B. Hale, School of Environmental Sciences, University of Guelph; W.D. De Matrando, CONICET-PRIET / PRIET

Toxic effects of single metals on aquatic environments are well established. In nature, organisms are exposed to a mixture of them at different bioavailability conditions. However, this situation is not always well studied. Here Lemma gibba were exposed to Ni, Cd and Zn individually and as ternary mixtures. The influence in the uptake and toxicity of dissolved organic carbon (DOC) as an environmental light was studied. Two sets of tests were performed 0.5 mg/L and 10 mg/L of DOC. The metal concentrations at the mixture tests were chosen by an incomplete factorial design, resulting in controls plus 20 test cases. Frond number inhibition (%FNI) and root growth inhibition (%RGI) were calculated at the end of 7-days tests. Determinations of internal dose [Mn], and external dose [Mn] were also conducted for all chronic tests. Single metal toxicity thresholds (IC25) were obtained for the three metals, resulting %RGI a more sensitive endpoint than %FNI in all cases. For the test with 0.5 mg DOC/L, Cd presented the higher toxicity, based on %RGI when concentration expressed as Mn (IC25Cd= 20.8 µg/g) being 10 times more toxic than Ni and 30 times than Zn. When concentration expressed as Mn(Cd+Zn) was also the more toxic metal (IC25Cd+Zn= 76.67 µg/g dry weight) being 10 times more toxic than Ni and 26 times than Zn. For the test with 10 mg DOC/L, Ni was the most toxic when dose expressed as Mn, but Cd when expressed as Mn(Cd+Zn). At the end of assays, for both DOC concentrations, [Cd]tot and [Zn]tot were higher in the single metal exposure compared to the mixtures. For the mixtures exposures, the %RGI responses ranged from 17 to 94 % in the lower DOC concentration test and from 15 to 97 % in the higher. Concentration addition (CA) model for the mixtures’ toxicity, through combinations of concentrations were used to calculate the ‘sum of toxic units’ (TU). Deviations from CA approach were observed as relative results according with the metal under analysis.

TH267
ISOLATION AND CHARACTERIZATION OF HEAVY METAL RESISTANT BACTERIA IN SOIL SAMPLES FROM MAMBILLA ARTISANAL MINING SITE, NIGERIA
O. Otojiu, federal University Wukari / Department of Biochemistry; T. Silas, federal University Wukari; A. Martins, S. Asemave, federal University Wukari / Biochemistry

Incidence of soil contamination by heavy metals is widely increasing with the spreading of industries. Artisanal mining activities, with the increase of the Mambilla plateau has been on the increase in recent years. Therefore, the present study was aimed at characterizing and determining resistance to lead, mercury and copper by selected bacteria strains isolated in soil from Mambilla Plateau artisanal mine and to explore their bioremediation capacity. Bacteria were isolated from soil samples obtained from different locations at the Mambilla artisanal mining site, Nigeria. Five (5) bacterial species were isolated through gram-stain analysis and were used to fit the observed metal mixture toxicity data to either Mn or Mn(tot). The concentrations of the three metals in mixture expected to result in 50% RGI or FNI were calculated by solving the regression for Cd while holding the concentrations of Ni and Zn constant for each of the 20 cases. To determine whether CA was the appropriate model for the mixtures’ toxicity, through combinations of concentrations were used to calculate the ‘sum of toxic units’ (TU). Deviations from CA approach were observed as relative results according with the metal under analysis.

TH268
The exceptions to the rule: Metal bioaccumulation in macroinvertebrates from metal polluted sites
B. Slootmaker, R.M. Town, Systemic Physiological and Ecotoxicological Research (SPHERE), University of Antwerp / Department of Biology; R. Blust, L. Bervoets, University of Antwerp / Department of Biology (SPHERE Research Group)

Surface waters are continuously facing a variety of anthropogenic stressors, including pollution, habitat degradation, and loss of connectivity. In such complex and dynamic environments it is challenging to unambiguously establish the effects of trace metal contamination on the resident organisms. The European Water Framework Directive (WFD) oblige member states to set specific water quality
guidelines for surface waters, in order to reach a good ecological water quality status for all water bodies. Nevertheless, many rivers and streams are still experiencing trace metal concentrations that exceed the current Environmental Quality Standards (EQS). In combination with other stressors, this situation may lead to an unfavorable shift in the composition of the ecological community due to a variety of direct and indirect effects. The range of concomitant contributing processes and the multitude of pathways by which trace metals may bioaccumulate in the aquatic environment and community will respond to the presence of a stressor(s).

To gain insights into the contributing factors, we are investigating eleven sites for which apparently contradictory effects are observed. That is, based on monitoring data gathered by the Flanders Environment Agency (VMM), the sites that have an exceedance of the EQS, yet a good ecological quality is obtained, and vice versa. In experiments with metric metal concentrations at the TH271

Mixture toxicity of ZnO and silver nitrate to Daphnia magna
M. Baek, KIST Europe; Y. Seol, University of Science and Technology; H. Kwon, Y. Kim, KIST Europe / Environmental Safety Group

Zinc oxide nanoparticles (ZnO NPs) and silver nanoparticles (AgNPs) as Engineered nanomaterials (ENMs) can be mainly found in numerous materials or consumer products. These applications of metal (oxide-) nanoparticles indicate that nanoparticles released into the aquatic environment may lead to mixture forms of by biological system. In this study, the acute toxicity tests using Daphnia magna were conducted for examining the single- and mixture toxicity. The methodological approaches for mixture toxicity (Mixture I – 5:5; Mixture II – 7:3 and Mixture III – 3:7) were conducted as three binary mixtures of AgNO3 and ZnO based on the estimated toxicity data (i.e., EC50 values) of single substance. To compare with control response and mixture results, the mode of action in mixtures, the effects of mixture were analyzed using the MIXTOX model. The EC50 values of AgNO3 and ZnO were 0.0009 mg/L (with a 95% CI of 0.0007-0.0011 mg/L) and 2.2884 mg/L (with a 95% CI of 1.3702-2.2066 mg/L), respectively. Among the 3 mixtures, Mixture III was the highest toxicity at the low concentration. With reference at the concentration addition (CA) and independent action (IA) model of all combinations of metal (oxide-) nanoparticles and the same concentrations, a mixture indicated an increased toxicity when the mixture effect was caused mainly by ZnO, and the positive bmax points of both models indicates a decreased toxicity (antagonism) when the mixture effect was due mostly to AgNO3. In the end the MIXTOX model was applicable for the prediction of combined effects of toxic compounds. Keywords: ZnO, AgNO3, MIXTOX model, nanoparticle
TH274 Sublethal toxicity of pesticide mixtures on early life stages of non-target aquatic organisms
E. Rozanka, RECETOX, Faculty of Science, Masaryk University / Research center for the toxicology and environmental risk, Faculty of Science, University of Bordeaux / EPOC: P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; L. Blaha, Masaryk University, Faculty of Science / Research Centre for Toxicology and Environment RECETOX; B. Morin, J. Cachot, University of Bordeaux / EPOC; P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; L. Blaha, Masaryk University, Faculty of Science / Research Centre for Toxicology and Environment RECETOX.

Pesticides are widely used throughout the world in many agricultural and domestic activities. By their presence in the environment, they can have an impact on non-target organisms. Moreover, due to the persistence of some products and the formation of active metabolites, more or less complex mixtures of pesticides can be found in the environment. Thus, the aim of this study was to evaluate the effects of one herbicide (S-metolachlor and its two metabolites) and an insecticide (imidaclopride) on the embryo-larval development of two non-target aquatic organisms. These pesticides are the most abundant representatives of their group in the aquatic environment. In this study, we focused on environmentally relevant concentration in this Bay (1 μg/L for herbicides and 0.2 μg/L for insecticide and 2-3 higher concentrations) and their sub-lethal effects on the oyster (C. gigas), which is widely present in the Bay due to oyster farms and the zebrafish (D. rerio), chosen as a prototypical (eco)toxicology model organism. Firstly, the embryos were exposed to the separate substances, then the mixtures for 5 days (zebrafish) or 2 days (oyster). The malformations, the locomotion activity and target gene expression levels were assessed to understand the mechanisms of possible sublethal toxicity of the selected pesticides. According to our results, no malformations and no effect on locomotion activity for the tested concentrations were observed for zebrafish. On the contrary, the effects on the malformations and the locomotion activity of the oyster larvae is already induced at low concentrations of the selected pesticides. The first results of the gene expression show an overexpression of some of the selected genes of zebrafish (12S, TR-beta – known to be related to the thyroid disruption) caused by one of the metolachlor metabolites. In conclusion, an indication of a novel mode of action of the chronic pesticide toxicity has been detected in zebrafish. The embryo-larval stages of oyster seem highly sensitive even to low environmental concentrations of pesticides.

TH275 Including multistress in risk assessment of pesticides. Current state of knowledge, based on a literature review and evaluation of tank mixture applications in a spraying schedule for strawberries.
P. van Vliet, Board for the Authorization of Plant Protection Products and Biocides; multistress, pesticides, environmental risk, aquatic Poster presentation

This study presents a number of stepping stones towards answering the question if the current product-by-product and active substance-by-active substance evaluation provides sufficient protection in the context of the authorisation of plant protection products (PPPs) in the Netherlands. This report is based on a literature review and an evaluation of tank mixture applications in a spraying schedule for strawberries. The topic of tank mixes has been identified by Ctgb (the Board for the Authorisation of Plant Protection Products and Biocides) as an important knowledge gap. We have quantified the environmental risk for an intensively cultivated crop with sequential applications of products and mixtures of products based on a realistic application schedule and spray drift on surface water in a ditch, the corresponding exposure profiles and the effects based on the Regulatory Assessment Procedure (RAP) of the used active substances. This study shows that the actual strawberry crop scenario is not protective for invertebrates and fish in surface water. Therefore, for the risk assessment of PPPs it needs to be considered that PPPs are part of a crop protection programme and thus should be evaluated in this context. Keywords: multistress, pesticides, environmental risk, aquatic Poster presentation

TH276 MODELLING ACUTE AND CHRONIC RISKS OF PESTICIDES RESIDUES IN SOUR CHERRIES
I. Simion, Gheorghe Asachi Technical University of Iasi Romania; R. Hilhor, Gheorghe Asachi Technical University of Iasi, Romania / Environmental Engineering and Management; P. Manuela Oltean, Phytosanitary Office / Department of Environmental Engineering and Management; M. Rosca, Gheorghe Asachi Technical University of Iasi Romania; P. Cosma, Gheorghe Asachi Technical University of Iasi Romania / Environmental Engineering and Management; M. Gavriluscu, Gheorghe Asachi Technical University of Iasi Romania / Department of Environmental Engineering and Management.

To destroy or prevent insects, rodents, and weeds that might harm agricultural crops, and to control and mitigate plant diseases, farmers started to use pesticides, which are highly toxic chemicals or mixtures. Due to their persistence in the environment and ability to bioaccumulate in living organisms, pesticides generate environmental and human health impacts and risks, which are in a complex relationship. The present study proposes a modeling strategy to evaluate acute and chronic risks of pesticides residues in sour cherries, considering different age groups and cluster models according to EFSA PRIMO model revised version 2. We initially applied 8 fungicides and 5 insecticides in four treatments during the phenological growth stages of sour-cherries according to Good Agricultural Practice (GAP), in double sampling ensuring a sufficient number of plants subjected to the experiments. We followed variation of environmental conditions: temperature, humidity, rainfall patterns and pesticide dissipation in time considering each treatment. The results of pesticides concentration at harvest allowed us to model the pesticides risks to human health. Based on our assessment, we identified a gap in the acute and chronic effects of pesticides residues in sour cherries which is high. Sour cherries dietary intake of pesticides residues poses an acute risk for children lower than 64.6% and lower than 22.5% for adults. The highest chronic risk level reached 2.4% for adults and 9.5% for children. Our study suggests that the risk assessment estimates are strongly influenced by age and dietary preferences.
environmental risk assessment. Bridging from the workshop discussions and conclusions, a new HSE Emerging Issues Committee was formed in late 2017, with the overall mission to develop a tiered approach to UVCB and MCS ecological risk assessment. Initial objectives of this committee are to identify and develop new models and methods, develop best practices and guidance, and engage with multi-stakeholder collaborative research projects. This presentation will highlight the initial goals and strategy of this multi-stakeholder, collaborative group.

**TH279 Environmental Risk Assessment of Technical Mixtures under REACH**

E. Hassold, W. Galet, German Environment Agency - UBA / IV 2.3 Chemicals; W. Dress, Federal Environment Agency (UBA) / Chemicals Adapting the classification of substances regulated under REACH end up in mixtures. During their processing and downstream-use substances are blended together in formulations, are reformulated for different uses and end up in a variety of products. REACH addresses the safe use of single substances in technical mixtures, but not explicitly the risks arising from joint effects and exposures of the components. In contrast to other substance-oriented regulations, not the authorities, but the registrants and downstream users have to assess and guarantee the safe use of the registered substances, formulations and products. Recently, some attempts have been made by industry organizations with the concept of LCID/SUMI to improve the assessment and communication of safe use conditions for technical mixtures. However, essential improvements are needed. The development of sound prioritization criteria is essential for a mixture assessment. But a sole consideration of the worst classified constitut is not only applies for a majority of substances and further hazardous substances may be missed. All substances with ecotoxicity data need to be considered together with information on uses and exposure. The methods for an assessment of mixtures including component-based approaches, whole mixture testing, identification of main drivers and tiered assessment strategies are in general available. These need to be transparently addressed, so that further calculations by other downstream users are possible. The quality and availability of hazard and exposure data is central and data (eventually considering an anonymization of CBI) needs to be communicated between registrants and downstream user in the supply-chain to reach the respective “mixture evaluator”, i.e. the formulator. Communication formats (e.g. extended SDS + SUMI) as well as central data bases seem promising and need to be built up. Indeed, detailed guidance and assistance is needed for formulators of mixtures to enable the assessment of a safe use of mixtures. An implementation in guidance documents needs to involve all stakeholders (authorities, industry, academia) and approaches should be followed and evaluated with respect to their feasibility and a sound risk assessment in case studies.

**TH280 Natural complex mixtures: Ecotoxic behaviour, what we know and what is next?**

R. Samsera, CETHRA SAS; N. Delpl, Laboratoires des Pyrénées et des Landes; P. Bichere, KREATIS; J. Rivera, A. Barret, C. durou, CETHRA SAS; P.C. Thomsen, CETHRA SAS / Economy is an issue as it only applies for a minority of substances and further hazardous substances may be missed. All substances with ecotoxicity data need to be considered together with information on uses and exposure. The methods for an assessment of mixtures including component-based approaches, whole mixture testing, identification of main drivers and tiered assessment strategies are in general available. These need to be transparently addressed, so that further calculations by other downstream users are possible. The quality and availability of hazard and exposure data is central and data (eventually considering an anonymization of CBI) needs to be communicated between registrants and downstream user in the supply-chain to reach the respective “mixture evaluator”, i.e. the formulator. Communication formats (e.g. extended SDS + SUMI) as well as central data bases seem promising and need to be built up. Indeed, detailed guidance and assistance is needed for formulators of mixtures to enable the assessment of a safe use of mixtures. An implementation in guidance documents needs to involve all stakeholders (authorities, industry, academia) and approaches should be followed and evaluated with respect to their feasibility and a sound risk assessment in case studies.

**TH281 Testing chemical mixtures: how to determine the effects concentration(s)?**

G. Deviller, DERAC / TERA PRAPS HSE When the properties of a mixture cannot be estimated from the related properties of its components then testing on the mixture is required under most chemical regulations. However, the available standard methodologies to assess the environmental fate and toxicity have been developed for single substances and are often not directly applicable to mixtures. The first issue is related to the identification of the relevant constituents to monitor during the tests (e.g. composition main constituents, bioavailable fraction... which may differ according to the substance regulatory frame(s). Second, the development of a specific and quantitative analytical method for each relevant constituent could be technically challenging because (1) all analytical standard substances might not be available since some constituents of the mixture are produced by reaction and (2) the different chemical nature of the constituents may require different type of analytical techniques that might not be all available in the (same) GLP testing laboratory. Once the analytical methods have been developed, the effect levels may arise during toxicity tests if one or more constituent’s concentrations vary during the exposure time. Indeed, if the constituents are found to be all stable, then the effect concentrations (e.g. ECx or NOEC) can be based on the nominal concentration of the mixture. But, in case the constituents have different degradation patterns during the test then, how the recommendation for single substances to base the effect concentrations on the measured concentration should be applied for these mixtures? This presentation is intending to discuss these issues and to bring some elements of response based on case studies.

**TH282 Deriving USEtox human non-cancer toxicity Effect factors from the REACH database for thousands of chemicals using R-Studio program**

F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; L. Ceriani, M. Fuaat-Gatnik, M. Pavan, S-IN Soluzioni Informatiche Srl; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC / Sustainable Assessment Unit The Product allegements that were identified include footprint (PEF/OF) methods form a core part of the European Commission (EC) Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” (2013/179/EU). Based on these methods, the potential impact on humans and ecosystems of chemicals emitted during the life cycle of a product is assessed via the USEtox model. To this aim, USEtox builds the model on upstream data for a chemical. Focusing on human health (HH), the EC Joint Research Centre has recently obtained from the European Chemicals Agency (ECHA) genotoxicity and repeated dose toxicity (RDT) data (41‘381 test results, as of March 2017) generated under the REACH Regulation. Based on these data, selection criteria were defined to automatically derive non-cancer HH toxicity effect factors (using R-studio) for thousands of chemicals in USEtox. Genotoxicity data were not retained in the assessment, being associated with qualitative outcomes, and rules for cancer HH effect factors were not derived, since the USEtox ED50, and cancer-TSD50 endpoints are not commonly provided under REACH. According to the USEtox methodology, specific fields of the REACH data, included in the RDT endpoint study records (ESRs) via the oral and inhalation route, were used to define selection criteria for non-cancer HH effects, in particular: reliability, adequacy, type of information, test guideline, GLP, species, duration of exposure, route of administration, effect level qualifier, effect level, unit, effect level based on, basis for effect levels. A tiered approach for selecting good quality data was also proposed, based on four quality levels, where studies of the highest quality (key studies, Klimisch 1/2) were included in the first two levels. The main challenges that were identified included the way of data reporting and detailing in ESRs, especially for some critical fields, e.g. endpoint, unit, test duration, of exposure, thus leading to the use of either general rules for computing reasons, or other fields in their substitution. Nonetheless, the final effect value per chemical (e.g. NOAEL), automatically derived from REACH data based on the developed criteria, coincided with the critical endpoint value chosen in the ESR in those cases of quality of cases. Based on this work, RDT REACH data for thousands of chemicals can automatically be selected and used for their life cycle assessment in USEtox.

**TH283 Deriving USEtox aquatic freshwater toxicity Effect factor from OpenFoodTox database (EFSAs) using R-Studio program**

E. Saouter, EU Commission JRC / Sustainable Assessment Unit; F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; L. Ceriani, S-IN Soluzioni Informatiche Srl; J. Dorne, European Food Safety Authority EFSAs / Scientific Committee and Emerging Risks Unit Department of Risk Assessment / AMU; D. Rognette, European Food Safety Authority EFSAs / Product Environmental Footprint (PEF) and Organisational Environmental Footprint (OEF) form a core part of the Commission Recommendation “on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations” (2013/179/EU). There are currently 25 PEF and 2 OEF pilots testing the method and developing Product Category Rules (PCR) with the potential input data of chemicals emitted during the life cycle of a product is assessed via the USEtox multimedia fate model [3]. This model requires ecotoxicity data to freshwater aquatic life. For PEF/LCA, those data are required for thousands of chemicals using the most up-to-date information [4,5]. The EFSA OpenFoodTox database was used to extract the information required to calculate effect factor for Plant Protection Products. EFSA has populated a chemical hazards database to hold summary hazard data from EFSAs’s chemical risk assessments in food and feed (Barbaro et al. 2015; Dorne et al. 2017). The data are freely accessible via the EFSA website OpenFoodTox but also accessible via downloadable Excel files. From the OpenFoodTox database, 2695 ecotoxicological observations were
available for about 451 chemicals. After selecting the appropriate data, species geometric means have been calculated for each taxonomic groups. The following final calculation have been performed for thousands of chemicals: - Acute and Chronic species geometric means with standard deviation and number of individual test available per species - Arithmetic average of all the log of the species geometric mean with standard deviation and count of species as well as count of SSD group for each chemical and Chronic species geometric means with standard deviation. Comparison of the chemical toxicity based on the above calculations and chemical ranking based on GHS and CLP.

TH284 Bioassays for assessing effects of overall risk from food contact materials K. B. Houghton | E. G. Eschen | Foundation; L. Muncke | Food Packaging Forum Foundation / General Management

Food contact articles (FCAs) are made from highly diverse materials, and they are chemically complex. FCAs can transfer their chemical constituents, the so-called food contact chemicals (FCCs), into foods. Exposure to FCAs is assumed to be highly relevant in the context of human exposure to (synthetic) chemicals. To assess the risk to human health from chronic ingestion of FCs, basic information on migratng chemicals must be available, such as their chemical identity. However, this is often not the case for all migrating FCs, especially the non-intentionally added substances (NIAs), as some or most NIAs typically remain unknown, depending on the type of FCA. Furthermore, the current approach to chemical risk assessment is focused on single substances, while it is known that migrating FCs migrate simultaneously, forming the “overall migrant” and resulting in typical and predictable mixture exposure scenarios. One alternative approach to estimating chemical hazards of FCs is to assess biological effects of the overall migrant. In addition to assessing mixture toxicity this approach also includes effect-assessment for unknown NIAs which otherwise remain unassessed. We review this approach, discuss benefits and disadvantages, and highlight future research needs.

TH285 A unique index to characterize the global noxiousness of stable and radioactive substances for both human health and ecosystems


Inspired by methods and tools developed in the field of life cycle analysis (LCA), we suggest using a hierarchy of indicators to appreciate the harm due to specific radioactive wastes and竽s for human and environmental health. Six impact categories were considered: human cancer and non-cancer effects on one hand, and ecotoxicity on the other hand, both considering chemotoxicity and/or radioactivity. For ecosystems, a comparative toxic unit has already been defined from which we derived our noxiousness index. It is based on the concept of Potentially Affected Fraction (PAF) used here as a damage indicator at the ecosystem level. This concept expressed initially the toxic pressure on the environment due to one chemical. It has been enlarged to mixtures of substances as multi-substances PAF (ms-PAF), and yet applied to a mix of stable and radioactive substances. Combining ecotoxicity data and a simplified model of exposure of fauna and flora, we proposed a chemotoxicity index and a radioactivity index, which definitions ultimately allow the definition of a single index. According to acknowledged practices in LCA and corresponding available data, we suggested declining this approach to human health, taking into account exposures resulting from both ingestion and inhalation pathways. This led to eight basic indices, which may be aggregated on substances, effects categories or exposure pathways to produce intermediate indexes. The principle of additivity that underlies the whole proposed approach may authorize complete aggregation in order to produce a unique index also for human health. Different source terms may be then easily directly compared in terms of human and ecological noxiousness.

TH286 Solution-focused application of mixture modelling and chemical footprints

M.C. Zigg, RIVM / Centre for Sustainability Environment and Health; J. van Gils, DELTARES; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; D. De Zwart, DZ Ecotex / Centre for Sustainability Environment and Health; D. van de Meeent, Association of Retired Environmental Scientists ARES / Environmental Science; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health

Status reports of the Water Framework Directive suggest many cases of non-compliance according to formal criteria for Good Ecological and Good Chemical Status as well as for River-Basin Specific Pollutants. This signals problems for both the assemblages of species and the functions we try to protect. Multiple stressors, including 100k chemicals and their mixtures, are the causal agents. In the FP7 project Solutions, a modelling train is developed with the purpose to support derivation of water quality management plans that provide best value for money regarding chemicals and their mixtures, i.e., help to identify the largest potential risk reduction per euro spent. Therefore, the challenge is to focus on those chemicals that matter most, which can result in prioritization to sites (where are largest impacts to be expected), to times (when are largest impacts to be expected, e.g., crop-growing season & pesticides), to affected species groups (which species (groups) are most sensitive to the present impact) and to compound (which chemical (groups) contribute most to local impacts). Collaboration with the FP7-project MARS (on multiple-stress effects on ecological status) forms a multi-stress, multi-chemical integration. In SOLUTIONS, the modelling train is applied to result in chemical footprints (ChF). ChFs were developed to summarize and communicate predicted mixture risks in simple units. In the current study, ChFs are evaluated in terms of the net contributions to predicted mixture impact of emissions in one region, e.g., a sub-catchment, on the mixture toxic pressure in the total river downstream, including the estuary. Hence, it extends the potential transfer of risk from one catchment to another, including the information that can be obtained by single-chemical risks, chemical footprints indicate which combination of chemicals and locations require priority for reduction. We present ChF-analysis results for the river Rhine. The river basin was divided in more than 800 sub-basins and chemical footprint information resulting from the emissions of a large amount of chemicals are derived from hydrology driven spatially and temporally explicit modelling for the whole catchment. Subsequently, abatement priorities are proposed, based on the ChF results, that act on the most severe combinations of chemical and region of emissions. The effects of local risk management are expressed in reduced toxic pressure in all downstream sections of the river.

TH287 One-week observation of phthalate metabolites in urine from 12 Korean adults: Exposure levels, profiles, and source identification

J. Lim, Hanyang University; S. Kim, Seoul National University Graduate School of Public Health; I. Lee, Seoul National University / Department of Environmental Health Sciences; A. Lee, Soonchunhyang University; S. Kim, Y. Kho, Eulji University; J. Park, Seoul CHUN HANG UNIVERSITY / School of Pharmacy; K. Choi, Seoul National University / Environmental Health Sciences; H. Moon, Hanyang University / Marine Sciences and Convergent Technology

The esters of phthalic acid (phthalates) are representative endocrine disrupting chemicals (EDCs) to cause a variety of adverse health effects to humans. Phthalates have been primarily used as additives of the plastic products, cosmetics and personal care products (e.g., DEP). Phthalates are metabolized and eliminated in urine within few hours after human exposure. Due to a short half-life of phthalates, the urinary phthalate metabolites are utilized as an indicative for integrative exposure to phthalates from multiple sources and pathways. In this study, all of the urine samples for 7 days (n=401) were collected from 12 adults to identify the integrative exposure levels and exposures profiles of phthalates for different population groups. Eighteen phthalate metabolites including mono-ethyl phthalate(MEP), mono-ethyl phthalate (MEP), mono(2-ethyl-hexyl) phthalate (MEHP), mono(2-ethyl-5-oxohexyl) phthalate (MEHOH), mono-2-ethyl-5-oxohydroxyethyl phthalate (MEHHP), mono-(2-carboxymethylphthalate) phthalate (MCMPH), and mono-(2-ethyl-5-carboxypentyl) phthalate (MECPP) were analyzed. Among 18 phthalate metabolites, MEHP, MEHOH, MEHHP, MCMPH, MECCP, MiBP, MEP, and MiBP were detected in almost all of the urine samples (detection rate >97%). However, MCP, MiPP, MiNP, MOP, and MPP were rarely detected in all of the urine samples (<10%). Total concentrations of phthalate metabolites ranged from 3.12 to 63.00 ng/mL with a median concentration of 104 ng/mL. Five DEHP metabolites (monoethylhexyl ester (methyl ester); 63 ng/mL; MBBP (median: 8.4 ng/mL), MBBP (6.8 ng/mL) and MEP (5.2 ng/mL) relatively showed higher concentrations than other phthalate metabolites. Our findings suggest the highest burden of DEHP from multiple sources. In the present study, we defined the peak showing the concentration higher than summation of average and double values of standard deviation as a specific source input associated with phthalate exposure. Tracking the exposure source of phthalates suggests that the major contribution of the phthalates exposure pathways was different depending on chemical properties (e.g., molecular weight) and usage of phthalates. The exposure of lower-molecular-weight phthalates such as DEP and DMP was associated with the consumption of cosmetics and personal care products, whereas the urinary DEHP exposure levels varied with the dietary intake. The present study provides an important information for intervention study to reduce phthalates from humans.

TH288 Integrating chemical monitoring data with high-content effects data to prioritize contaminants and hazards in chemical mixtures

P. Morén, D. Martinez-Weigelt, University of St. Thomas / Biology; A. C. Mehinto, Southern California Coastal Water Research Project / Toxicology; N. Vinas, US Army Engineer Research and Development Center; A. Schroeder, University of Minnesota-Crookston / Math, Science and Technology; E. M. Curran, University of St. Thomas; C. Lai, University of St. Thomas / School of Engineering; Y. He, University of St. Thomas / School of Engineering; M.L. Ferrey, Minnesota Pollution Control Agency / Environmental Outcomes

Determining ecological risks associated with exposures to complex chemical mixtures in the environment is challenging. Bioeffect-monitoring tools that can measure integrated biological activity of mixtures have been proposed as one of the tools to tackle the challenges of higher order mixture effects. In this study, we examined the potential use of gene expression analysis as a tool to evaluate the combined effects of chemical mixtures on different species. Specifically, we examined the potential use of gene expression analysis as a tool to evaluate the combined effects of chemical mixtures on different species. The use of gene expression analysis as a tool to evaluate the combined effects of chemical mixtures on different species.
the solutions. A limitation of these is that they typically do not provide insight into which chemicals are causing the observed biological responses. Utility of methodologies that integrate chemical monitoring with bio-effects data to prioritize chemicals and hazards in complex mixtures will be discussed. More specifically, outcomes of a Minnesota streams case study are used to critically evaluate approaches where: 1) prior knowledge regarding toxicity of detected chemicals is combined with empirical, in situ bio-effects assessment; and 2) where in situ chemical and bio-effects data are integrated directly (without the prior knowledge of toxicity of individual chemicals). Samples from 50 randomly selected locations in Minnesota were analyzed for 146 chemicals of emerging concern. Concurrently, at 10 sites, exposures of fathead minnows to stream water were conducted (48h, custom 60K feature microarray platform, liver, N=70). Site chemistry and public bio-effects data for individual chemicals were integrated to prioritize chemicals and predict biological targets of detected chemicals for each site. Partial least-squares (PLS) regression and association rule learning (AR) were used to identify associations between in situ chemistry and in situ transcriptomic effects. At most sites, both prior knowledge-based predictions and fish transcriptomics, indicated activation of estrogen receptor alpha and peroxisome proliferator-activated receptors; their predicted chemical initiators were bisphenol A, caffeine, carbamazepine, and triclosan. Some chemicals (triclosan) were indicated by both knowledge-supervised and direct data integration approaches, but iodamidol (detected at 78% of MN sites) and metformin were only indicated by PLS and AR. Estrogenic effects remain of special concern as all methodologies indicated disruption or estrogen receptor signaling. Collectively, additional in situ toxicity was gasoline of unknown source. These three health hazard databases, and relatively small sample sizes pose challenges for utility of PLS and AR, whereas poorly populated knowledge bases, lack of fish-specific data and poorly characterized in vitro models are problematic for knowledge-based predictions.

TH289

CENTRAL ASIA POLLUTION: OBESO TAILINGS, OBESO T PESTICIDES, OBESO T GASOLINE AND HUMAN HEALTH DISORDERS

I. Hadjambelev, Toxic Action Network Central Asia; Chief Scientific Officer; A. Rospokova, Asian Medical Institute named Tentishiy; V. Didenko, Asian Medical University named Tentishiy; I. Knaizev, Asian Medical Institute named Tentishiy; B. Hadjambelev, Toxic Action Network Central Asia

We study the radioactive and toxic wastage health impact: in areas of tailings and obsolete pesticides, and severe air-environment pollution by obsolete gasoline. They all have the same targets - immunity, genetic, endocrine system. The old uranium tailings of former USSR military industry in Central Asia, in North Tajikistan (tremendous Degnay); in Kyrgyzstan – 29 tailings (high concentration in MailuuSuu river cost), in Uzbekistan 11 tailings and mines. Total radioactive wastages volume of three CA countries – 700 mln ton. There are 268 warehouses of obsolete pesticides and abandoned airfield used for agro pulverization. These warehouses and tailings could pollute distant areas of CA by infiltration by rivers. Additionally, toxicity of gasoline was on the rise due to the small cars. These three health hazard areas have the same common impact common targets – immune system and genetic system of human. We made map of most danger areas (it has been using irrigation water and under ground water stream, air condition, etc). After that, real level of pollutants was analyzed: Uranium, DDT-DDE cost - in drinking water and meat; PHB and benzpyrene in room air. There were used research tools (GIS System programs; Manual Interventional Chemist Analytic Association; Manual - Disease Mapping and Risk Assessment; etc). Numerous health disorders (in children and pregnant women) of polluted areas were found: abnormal high level of goiter and chronic lung diseases; disorders of immune status in 1,2,3- levels; lower clearance via renal; higher permeability of cell membrane (liver, erythrocytes); leucocytes chromosomal disruption tests. Close correlation between two (or three) toxicant levels and health markers of abnormality was found. Mutual, interconnected impact of different pollutants cause synergetic effect on human’s health marker. We offered results of the research and recommendation for five local and two national governments. Specific actions were: 1) to installing special mark: danger-uranium, or/and DDT, or/bad air; 2) resettled seventeen families for most dander points; 3) implementing order of pregnancy hospitalize-time would be in comparatively clear town district.

TH290

Evaluating HPC ingredients in WWTPs & surface water of the Songhua River catchment (China) using a high tier modelling framework and monitoring. The aim of our study was to advance understanding in the occurrence and fate of ingredients found in HPC products in the Songhua catchment, in particular 1) to assess spatial trends in the catchment, and 2) to evaluate and improve modelling predictions. Methods: A monitoring campaign was carried out by IJC-PTS, in the Songhua catchment (China) undertaken from June-July 2017, sampling WWTPs and watersheds. Toxic Unit concentrations were determined based on product sales data for China and were input into the modelling framework. The hydrobasins hydrological dataset has been integrated within the Pangea multimedia modeling framework, using the hydrological flow between each basin and its downstream basin to parameterize the transfer rates from the corresponding water compartments. Results: Initial hydrobasins results for the Songhua catchment indicate the concentration of HPCs are dominated by LAS in WWTPs and rivers. Modelled influent concentrations show good agreement with measured concentrations for most ingredients, demonstrating emission estimates are reasonable. WWTP median measured removal rates range from 90.6% for TCS up to 99.8% for LAS. In the freshwater compartment there is good agreement, with the model overpredicting concentrations for most ingredients. Conclusion: One way combined modelling and monitoring approach is advantageous for assessing exposure, as monitoring data can be used to evaluate model predictions and refine parameterization while modelling provides feedback to improve the representensens of sampling. This method enables a more detailed analysis of the key sources of uncertainty and variability at each step of the modelling framework (i.e. model, effluent and river concentrations). Further work to understand the uncertainties in both monitoring and modelling will be carried out in a monitoring campaign in November 2017.

TH291

Microexposome experiment evidences complex responses of biofilm communities along a gradient of chemical pollution

1. sabater, CSIC-IDAEA / Department of Environmental Chemistry; A. Ginebrea, Institute of Environmental Assessment and Water Research IDAEA CSIC / Department of Environmental Chemistry; O. Pereda, University of the Basque Country; F. Romero, ICRA Catalan Institute for Water Research; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry

Freshwater ecosystems are receivers of chemical pollution, which has been recognized as one of the major causes of river impairment. Wastewater treatment plants (WWTP) are point sources of contaminants in natural receiving waters but information about their effects in the ecosystems is still scarce. Ecosystems are known to react to each environmental change by initiating a series of ecological chains of effects. In this context, the objective of this study is to verify whether robust and resilient is an ecosystem to WWTP effluents using a microexposome experiment which have been revealed as particularly convenient tool to study biological communities’ responses. We exposed twenty-four artificial streams to a range of WWTP effluent concentrations, from no effluent to pure effluent and under controlled conditions of light and water flow during 34 days, followed for 22 days of recovery. Further no effluent conditions. We analysed river biofilm inhabiting in sediments and cobbles surface because of its major role in ecosystem functioning. To assess impact and recovery we measured Chlorophyll-a content, Chlorophyll-a fluorescence measurements, extracellular enzyme activities (APA and LAP), algal community and metabolism at weekly scale. Pollution load associated to the WWTP effluent was characterized analyzing physical-chemical parameters (pH, dissolved oxygen, conductivity and temperature), nutrients, organic matter, heavy metals and microcontaminants in the water phase. Our preliminary results indicate a complex response of stream ecosystem functioning in front of the WWTP effluent. We notice changes on the system balance and the final return to equilibrium. Acknowledgements - The research leading to these results has received funding from the European Comunities 7th Framework Program through grant agreement No. 603629-ENV-2013-6.2.1-Globaqua

TH292

Risk assessment of chemical mixtures in the Erft river basin

North-Westphalia State Environment Agency (LANUV NRW) / FB 32; U. Rose, M. Trimborn, Erftverband

Mixture toxicity was assessed using extensive chemical monitoring data from the river Erft, its tributaries, and ten municipal waste water treatment plants (WWTPs) discharging into the Erft river. Toxic Unit concentrations were obtained assuming concentration addition and using acute toxicity endpoints for algae, macrophytes, daphnia and fish. Substances with high TU as well as the taxonomic classification of the solutions. Additional single substance risk assessment was performed by determining risk quotients (environmental concentrations/PNEC). Risk quotients larger than one indicate a possible risk for aquatic organisms. SUM TU were mainly
explained by few compounds which varied between sampling sites and dates (e.g. seasonal use of pesticides). Overall, WWTPs increased mixture toxicity in the receiving surface waters. For most samples highest SUM TU could be calculated for macrophytend algae. As a substance highly toxic for algae Triclosan generated high TU. It was detected in nearly all WWT effluents but in surface waters it was only rarely present in concentrations above LOD. Triclosan can be considered to be the key compound of the mixture toxicity found even at concentrations below LOD. Pesticides often generated high TU but due to the seasonal application substance patterns varied strongly between sampling dates and different locations. Highest pesticide concentrations in surface waters were measured during heavy rainfall which caused run-off from arable land. Single substance risk assessment identified mainly Triclosan, Bisprofen and Dichlofenac as substances with a possible risk for the aquatic organisms. In waterbodies strongly influenced by WWTP discharges Dichlofenac and Bisprofen were nearly ubiquitous and caused high chronic toxic stress to fish. It was concluded that a combination of single substance risk assessment and mixture toxicity assessment is a suitable tool to evaluate complex monitoring data. Monitoring of substances with high TU (contributing mainly to mixture toxicity) could help to identify surface water for a more extensive monitoring and support specific management planning.

**TH293** Assessing groundwater toxicity of emerging contaminant mixtures
M.D. Pavlišák, University of Aveiro / Department of Biology; J.F. Mousinho, University of Aveiro / Department of Biology and CESAM; A.R. Silva, University of Aveiro / Dept. of Comp. & CESAM; S. Goncalves, University of Aveiro / Department of Biology & CESAM - University of Aveiro / Department of Biology and CESAM; R. Morgado, University of Aveiro / Department of Biology and CESAM; S. Loureiro, Universidade de Aveiro / Biology
Groundwater is one of the most important natural resources, as globally it comprises the primary available source of freshwater. Groundwater aquifers consist in an important drinking source in many parts of the world and a point of supply for irrigation in agriculture, among others. Additionally, groundwater aquifers are considered valuable in sustaining ecosystems’ health and functioning. The Groundwater Directive (2006/118/EC) was created to protect groundwater bodies from contamination but to date it does not consider a diverse array of emerging contaminants in great quantities by society. These emerging contaminants can often occur in mixtures rather than alone, therefore understanding and predicting the toxicity of such complex mixtures, will eventually lead the way to developing new strategies for setting adaptations in regulations. Additionally, adapting surface water protocols to groundwater contamination scenarios might lead to erroneous results due to water different composition. The present work was performed in the context of the European Research Project WE-NEED (Water JPI- WATERWORKS2014 ERA-NET) focused on developing new management strategies to sustainably exploit groundwater resources. A thorough identification of emerging contaminants took place in two well-characterized case-studies, the Bologna and Cremona aquifers. For that, four priority contaminants identified in the two aquifers were chosen as model chemicals and synthetic water was built to mimic groundwater from these University of Aveiro / Department of Biology and CESAM. Daphnia magna and deviations from the Concentration Addition reference model were assessed. Based on this step, the toxicity of three emerging compounds and their mixtures (binary and ternary) were assessed in the two synthetic groundwaters using adapted standardized protocols for Daphnia magna (OECD 202) and Danio rerio (OECD 203) to assess the modifying effect of combining binary mixtures was used to predict the effects of the ternary mixtures. Deviations from the Concentration Addition reference model indicate interaction between the contaminants in D. magna and D. rerio.

**TH294** Mixture effects of Dibutyl phthalate and Sodium dodecyl sulphate on a mesozooplankton community from the Swedish west coast
C. Jonander, University of Gothenburg; I. Dahllof, University of Gothenburg / Biological and Environmental Sciences; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences
In general coastal ecosystems are not present on their own but in mixtures. A chemical monitoring survey detected more than 60 organic compounds along the west coast of Sweden in 2012, many of which exceeded their environmental thresholds. A total of 33 chemicals was found to co-occur in the water column of the coast of Stenungsund, an area with multiple harbours and home to Sweden’s biggest chemical industry cluster. Dibutyl phthalate (DBP) and Sodium dodecyl sulphate (SDS) were among the highest risk substance and mixture toxicity to natural mesozooplankton communities, which constitute an important link between primary producers and higher trophic levels like fish. Structurally diverse communities generally possess a large resilience capacity, and it is thus essential to identify sensitive species and structural changes caused by chemical exposure. Potentially, structural changes on this level could indirectly affect even higher levels of biological complexity. We used copepod egg production, hatching success and feeding rate as our primary ecotoxicity parameters, complemented with dead/alive staining of zooplankton with neutral red after the exposure. Additionally, we analysed the community structure before and after chemical exposure by image analysis, comparing images of the exposed samples and untreated controls to a manually classified reference library of mesozooplankton taxa. Single substance experiments show toxic effects on the zooplankton communities by decreasing copepod egg production and hatching success in a concentration-dependent manner, with first effects becoming visible at concentrations of 0.20 µmol/L (DBP) and 0.32 µmol/L (SDS), respectively. The combination of structural endpoints as well as the mixture experiments are currently (Nov. 2017) ongoing and will be presented on the poster.

**TH295** Analysis of the Mixture Toxicity Burden in 17 Rivers in North Eastern Australia - Implications for the Great Barrier Reef.
F. Spilsbury, University of Gothenburg / Dept of Biological and Environmental Sciences; M.S. Warne, Coventry University / Centre for Agroecology, Water and Resilience; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences
The Great Barrier Reef (GBR) is a protected ecosystem, listed as a UNESCO World Heritage site since 1981. It runs for approximately 2000km along the coastline in north-eastern Australia. A total of thirty-five major river basins discharge to the GBR and many transport large loads of pesticides, suspended sediment, nutrients from agricultural land. Over the past 6 years an extensive program has been conducted by the Queensland Government to monitor concentrations of 51 pesticides and their breakdown products in 17 rivers that discharge to the GBR. To explore the potential impact of the pesticides on these riverine environments and to the GBR we analysed the risk posed by the individual pesticides and their mixtures. Australia currently does not have water quality guidelines for 17 of the 38 pesticides detected. For those, we calculated ecotoxicity thresholds using a simplified version of the Australian methodology for determining water quality guideline values, based on species-sensitivity distributions. In all rivers, multiple pesticides were routinely detected at or above concentrations that exceed their level of reporting. All rivers had at least one sample where the combined toxicity was greater than 1 TU (TU), i.e. exposure situations where the total pesticide concentration exceeded acceptable levels. In a number of rivers more than 50% of samples had a combined toxicity greater than 1 TU. Average TU’s per river ranged from 13.47 to 0.10, with substantial fluctuations over the seasons but without clear trends between years. The patterns indicate that specific events such as severity of wet/dry seasons and cyclone events impact the combined toxicity found. We also found land use patterns affected the combined toxicity in the river ecosystems. In each of the rivers, 90% of the expected mixture toxicity was caused by only between 2 and 6 pesticides, although the individual pesticides that dominated the combined toxicity differed between rivers.

**TH296** Physiological and transcriptomic responses in the tropical coral Stylophora pistillata to inorganic sunscreen exposure.
A. Tagliati, Heriot Watt University / Institute of Life and Earth Sciences; S.J. Kerr, Heriot-Watt University / Institute of Life and Earth Sciences; D. Magagnini, University of Aveiro / Department of Biology and CESAM; R. Morgado, University of Aveiro / Department of Biology; J.F. Mousinho, University of Aveiro / Department of Biology; S.J. Kerr, Heriot-Watt University / Institute of Life and Earth Sciences
Between 16000 and 25000 tons of sunscreen are used annually in tropical countries with tourism linked to coral reefs considered to be one of fastest growing tourism sector worldwide. Sunscreens are complex mixture of UV filters, emollients, and emulsifiers, and at least 25% of the cream is washed off from the user skin during swimming or sunbathing. The lipophilic properties of sunscreen makes them resistant against degradation of these compounds, sunscreen products can reside in coastal waters and potentially biocumulate in aquatic animals. Therefore sunscreens may pose a major threat for marine organisms in the shallow water near tourist beaches. Organic UV-filters have been documented to cause bleaching both in adult and larval stages of corals but only few studies have addressed the impact of inorganic sunscreens. A common component of inorganic sunscreen are titanium dioxide nanoparticles (nTiO2) which are widely used as UV-filters in the cosmetic industry due to their transparency and broad spectrum protection along with absence of skin irritation. Results from previous experiments on corals’ symbiotic algae Symbiodinium indicate that sunscreen toxicity is likely driven by the oil and not the filter nTiO2, and it is independent of the tested concentration of the UV-filter nTiO2 in the cream. Thus in the present study the tropical coral Stylophora pistillata, a common model coral species, was exposed to increasing concentrations of custom-made sunscreen formulations with and without the UV filter nTiO2 to characterize the responses of the chemical mixture either containing or not nanoparticles in it. A series of short-term (5 days) experiments was carried out to compare effects of these sunscreens on corals, by studying coral photophysiology, coral respiration, symbiont density and chlorophyll content. The expression of genes involved in thermal stress (HSP70), carbon absorption (intra and extracellular carbonic anhydrase) and calcium and ATP exchange (CA-ATPase) were also analysed to characterize Stylophora pistillata transcriptomic response to sunscreen exposure. Results from this work will be presented and compared to other studies carried out with organic sunscreens. Results from the present studies are essential to understand how the exposure to inorganic sunscreens affects reef-building corals, and they will contribute to the development of effective conservation programs and support eco-tourism
The worldwide demand for fuels is increasing, but currently used fuels are based on fossil resources. A possible alternative for diesel is the biofuel mixture of 1-Octanol (1-Oct) (80%) and DN-n-butyly ether (DNbE) (20%). These fuels are based on the raw material lignocellulose and are bio-degradable. However, this fuel mixture includes the risk of the environment contamination, especially for aquatic ecosystems. This study focuses on the ecotoxicological evaluation of this mixture and the investigation on a possible interaction between the two substances. Acute embryotoxic and developmental effects were investigated in the fish embryo toxicity test (FET) with Danio rerio (OECD 216). The acute immobilization assay (OECD 202) was performed to determine the acute toxicity of this mixture. To interpret the results for possible interactions between the two substances, the interaction between the FET's EC50 and LOEC was determined. The determination of the acute EC50, LOEC values in bioassays suggest an additive mode of action of the compounds. The comparison of the determined values with other biofuels (2-methylfuran, 2-methylterahydrofuran) showed a higher toxicity of the mixture. DnbE showed a higher toxicity on D. magna than the tested mixture. For the comprehensive ecotoxicological assessment of the mixture and those compounds as a single substance further tests are required. Especially regarding to the possible impairment of the hatching of D. rerio. Preventing of slippage can cause larvae to be no longer viable, resulting in a misinterpretation of the determined EC50. In future, further ecotoxicologically relevant endpoints should be investigated. This work was performed as part of the Research Cluster “Tailor-made fuels from biomass” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.
inherent to the use of the insecticide abamectin and the fungicide difenoconazole, the main objective of this research was to evaluate the effect generated in *Danio rerio* embryos exposed to pesticide mixtures and evaluate the effects produced by the interaction of these compounds. For this, *Danio rerio* embryos were exposed for 96h to the binary mixtures of abamectin and difenoconazole following the recommendations of OECD TG 236. The concentrations used were 0.5; 1; 1.24; 5.3 and 1.7 mg L\(^{-1}\) of abamectin and 0.2; 0.5; 1; 2.3 and 5.0 mg L\(^{-1}\) of difenoconazole. The factorial design was used combining all possible concentrations, and in total 35 treatments plus the control were performed. The exposures were performed in 50 mm Petri dishes using three plates per treatment. In each plate containing 15 ml of solution were arranged 5 eggs totaling an n = 15. Survival data were recorded every 24 hours and the results were analyzed in the Minitab software. The results obtained show that the binary mixtures of abamectin and difenoconazole promotes in *Danio rerio* embryos the antagonistic effect in the lower concentrations, but in higher concentrations the produced effect is synergic. This means that, at lower concentrations the interaction of abamectin + difenoconazole seems to decrease the toxicity of pesticides to *Danio rerio* embryos, but the toxicity of the compounds is potentiated at higher concentrations of the mixture. Similar results were also reported in other studies with combinations of monocomponents exposed to mixtures of these same compounds, but complementary studies are necessary to better understand the toxicokinetic of these pesticides mixtures.

**Emerging technologies and related raw materials requirements scenarios: the role of life cycle thinking (P)**

**TH305** Critical raw materials in a new building integrated photovoltaic system

D. Garrain, I. Herrera, Y. Lechón, CIEMAT / Energy Dept Energy Systems Analysis Unit

REELCOOP, an EU-FFP funded project which stands for RENewable ELectricity COOp (www.reelcoop.com), aims to develop and test novel prototypes of photovoltaic electricity generation technologies. One of the prototypes is a solar photovoltaic (PV) ventilated façade (6 kW) and involves the development of c-Si solar cells, as well as the study of the ventilation effect in PV façades. PV solar panels have particular metals or rare earths that are potentially included in the category of ‘critical raw materials (CRMs)’. This work aims to identify the potential CRMs in this prototype and to define several ways to improve the sustainability from a life-cycle approach, including aspects like substitution or recycling of these materials.

**TH306** Environmental sustainability assessment of a biological Active Pharmaceutical Ingredient: A resource based Life Cycle Assessment

A.G. Renteria Gamiz, Ghent University / Department of Sustainable Organic Chemistry and Technology; W. De Soete, Ghent University / EniVOC; B. Heirman, Johnson and Johnson / EHSS Product Stewardship; J. De Graaf, Jansen Biologics / Safety Health Environment; S. De Meester, Ghent University / Department of Industrial Biological Sciences; J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology

Most Life Cycle Assessments (LCAs) performed in the pharmaceutical sector have been done on chemically synthesized drugs, leaving biopharmaceuticals aside. The fact that sustainability assessments of biopharmaceutical products and technologies have been rarely done is probably a consequence of the major challenge that building a robust Life Cycle Inventory (LCI) represents for the upstream and downstream processes of biologics. However, the low number of LCAs performed on biopharmaceuticals does not reflect the current reality of the pharmaceutical sector, as its market is rapidly growing at an annual rate of around 9%. Therefore, this study focuses in performing a resource based LCA to measure the environmental impact of a biological Active Pharmaceutical Ingredient (API). A resource based methodology was used for addressing the task that aims to identify the most efficient way to supply and efficient use of resources. The API investigated is infliximab, a monoclonal antibody that treats autoimmune diseases. An Exergetic Life Cycle Assessment (ELCA) was conducted, using the Cumulative Exergy Extracted from the Natural Environment (CEEINE) method. First results show that the unit operations with the highest impact are: i) The first chromatographic process for purification (Direct Product Capture), since it requires the highest quantity of buffers which are produced using chemicals as well as complex organic compounds such as amino acids. ii) Fermentation, as similar complex components are required for its medium, which are also produced through biotechnological processes. Furthermore, fermentation is the process that takes the longest (several days), leveraging the Heating Ventilation and Air Conditioning (HVAC) system to achieve the clean room conditions needed for the production of biologics. HVAC has shown to be the utility with the highest impact, consuming a significant percentage of the total electricity used in the plant. Performing an LCA on a biologic mainly using primary data has been proven to be a possible task. However, challenges such as the data unavailability of biotechnologies used to produce the nutrients needed throughout the process, as well as the further integration of these technologies into databases should be addressed.

**TH307** LCA methodology: a case study of the industrial production of terephthalic acid from renewable sources

Cavani, Toso Montanari Department of Industrial Chemistry, University of Bologna / Dept. of Industrial Chemistry; P. Mizsey, D. Fozer, Budapest University of Technology and Economics / Department of Chemical and Environmental Process Engineering

The scope of the present study is to investigate the environmental sustainability of different routes of terephthalic acid (TA) production, comparing the results achieved by the traditional way with those of three bio-based routes. The aim of the study is to identify which of the selected pathways has the lowest environmental load. Below the four routes selected are briefly described: Traditional way: p-xylene is obtained from catalytic reforming of crude oil as part of extracted BTX (benzene, toluene and xylene isomers); GEVO’s process: isobutanol from the fermentation of biomass is converted into hydrocarbons, iso-octene and p-xylene; From HMF: HMF and ethylene: it involves the production of HMF (5-hydroxymethylfurfural) from starch, its conversion to DMF and the Diels-Alder reaction with bio-ethylene to obtain p-xylene; Alternative pathway from p-cymene: it consists in the oxidation, using O₂ in the presence of a catalyst, of p-cymene (derived from orange peels) to obtain TA. The first two routes are already set at industrial level; the others are still under development. Therefore, in order to estimate the environmental impact of the four pathways, a simulation of the commercial processes was carried out using ChemCad software. The first three syntheses are based on the production of p-xylene, subsequently oxidized to TA through the Amoco process. On the contrary, the last route is proposed as an alternative way, since it uses p-cymene as a precursor of TA. In order to perform the comparison, a LCA (Life Cycle Assessment) methodology has been used as a scientific tool of energy capacity, residence of a local power plant, etc., in each scenario. LCAs can evaluate the environmental impact associated to the entire life cycle of a product, in our case ton of terephthalic acid. The model was developed using the software SimaPro and the results indicate that bio-based processes are sustainable only if they use organic residues as raw materials. Both analysis methods used, CED and ReCiPe, have shown that the alternative way from orange peels has the lowest environmental impacts than the traditional way from crude oil. For the other processes, the cultivation and transformation of biomass present an environmental weight that does not justify their use as starting materials for p-xylene, and then TA, production. Thanks to this work it was also possible to make some considerations about energy requirements and their weight in the life cycle of the processes.

TH308
Environmental assessment of vanadium redox flow batteries
C. Minke, Technische Universität Clausthal / Energy Research Center; J.F. Peters, Karlsruhe Institute of Technology KIT / Helmholtz Institute Ulm HHI; M.J. Baumann, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis; M. Wotschack, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis ITAS

The rising production of electric energy from renewable sources requires electrical energy storage systems to compensate for the fluctuations in energy generation. The vanadium redox flow battery (VFB) is a suitable technology for stationary energy storage on a broad scale. Due to the independent scalability of system power and energy capacity, it is applicable within all sectors of the energy market. LCAs can be used to evaluate the environmental impact of production processes. The vanadium redox flow battery is one of the most promising technologies for sustainable energy systems that do not demand their use as starting materials for p-xylene, and research is ongoing. The VFB technology has been further developed and commercialized. The functional unit has been defined as a “printed flexible battery” to be used for powering the electrical vehicle and the scope of the study has been defined within the life cycle analysis framework for processes with only one process step (ISO 14040:2006 and ISO 14044:2000).

TH309
Towards the Life Cycle Assessment of engineered nanoparticles production: a comparison between batch and continuous flow synthesis
E. Grimadis, University College London / Department of Chemical Engineering; M. Pucciarelli, University College London / Chemical Engineering; A. Gavrilidis, University College London / Department of Chemical Engineering; P. Lettieri, University College London / Chemical Engineering

The aim of this study is to provide an assessment of continuous micro/milli-flow technologies applied to Engineered Nanoparticles (ENPs) production, benchmarking them against the conventional batch productions. As the quantity of ENPs produced and their applications are steeply growing, an increasing attention is being paid to the quality of the product and the efficiency of the synthesis. Continuous micro/milli-flow (CF) synthesis is considered to be the nature evolution of the currently most diffused conventional batch synthesis, as it intensifies the production in terms of productivity, energy and chemicals use, product quality and functionalisation. Given the importance and potentiality of the transition, an evaluation of these new technologies is needed. Life Cycle Assessment is the chosen methodology for addressing this objective, as it looks deep into the sustainability, efficiency and environmental impact of the system considered, in order to identify the key parameters for a deliberate green process design. The application of the LCA methodology to ENPs production presents many challenges: to date, few LCA studies within the manufacturing process of ENPs have been carried out. In this work, a wide selection of ENPs production is modelled and analysed, using GABI and LCPC. The CF syntheses are evaluated on a lab scale, performing a hot-spot analysis and benchmarking them against the equivalent batch syntheses. The output of the assessment permits valuable considerations on the best equipment materials, solvents, stabilizers, type of heating and mixing for maximising the efficiency of the process, even at the very early stages of its development. The results obtained highlight a general favourable tendency toward the CF system as a greener and more efficient way of ENPs synthesis than the correspondent batch production.

TH310
LCA of nanomaterials production for the emerging technology: the case of printing batteries
I. Battezzati, E. Sarti, F. Riera, LEITAT / Sustainability Division; I. Sánchez, LEITAT / Sustainability Division; A. Gavrilidis, University College London / Chemical Engineering; A. Pucciarelli, University College London / Chemical Engineering; A. Gavrilidis, University College London / Department of Chemical Engineering; P. Lettieri, University College London / Chemical Engineering

The aim of the present study is to develop high efficiency solar harvesting CSP architectures based on the conventional batch productions. As the quantity of ENPs produced and their applications are steeply growing, an increasing attention is being paid to the quality of the product and the efficiency of the synthesis. Continuous micro/milli-flow (CF) synthesis is considered to be the nature evolution of the currently most diffused conventional batch synthesis, as it intensifies the production in terms of productivity, energy and chemicals use, product quality and functionalisation. Given the importance and potentiality of the transition, an evaluation of these new technologies is needed. Life Cycle Assessment is the chosen methodology for addressing this objective, as it looks deep into the sustainability, efficiency and environmental impact of the system considered, in order to identify the key parameters for a deliberate green process design. The application of the LCA methodology to ENPs production presents many challenges: to date, few LCA studies within the manufacturing process of ENPs have been carried out. In this work, a wide selection of ENPs production is modelled and analysed, using GABI and LCPC. The CF syntheses are evaluated on a lab scale, performing a hot-spot analysis and benchmarking them against the equivalent batch syntheses. The output of the assessment permits valuable considerations on the best equipment materials, solvents, stabilizers, type of heating and mixing for maximising the efficiency of the process, even at the very early stages of its development. The results obtained highlight a general favourable tendency toward the CF system as a greener and more efficient way of ENPs synthesis than the correspondent batch production.

TH311
Life Cycle Assessment (LCA) applied to new and advanced material solutions in Concentrated Solar Thermal technology
A. Claret, Leitat Technological Center / Sustainability Division; S. Vazquez, ACONDICIONAMIENTO TARRASENSE (LEITAT TECHNOLOGICAL CENTER) / Sustainability Division

The benefits of high efficiency concentrated solar power (CSP) and photovoltaic (PV) are numerous: environmental protection, zero-carbon process, energy security and economic growth. CSP has advantages in front of PV: possible 24h continuous electricity production, electricity and heat generation, heat for distributed in combination with energy storage. Thanks to this work it was also possible to make some considerations about energy requirements and their weight in the life cycle of the processes.
High-operating-temperature thermal storage materials for TES increasing up to 3 times the thermal capacity. All these solutions are being assessed through a comprehensive LCA, considering the entire life cycle of materials and components, from raw material extraction until the end-of-life. A comparative analysis is being prepared between baseline scenario (with reference materials) and the scenario with the IN-POWER innovative materials. Along the project different candidate materials and approaches are being assessed. Comparable process looking for high performance but environmentally friendly. Some improvements are being made such as: use of aluminum instead of silver in the mirror reflective coating, to meet the European requirements for use of non-critical materials; the reduction of materials weight; and the increase in materials robustness. The expected results are to: Obtain a complete environmental profile of IN-POWER CSP architecture, Calculate the environmental impacts associated to: new polymeric materials for mirrors; high absorber coating; high thermal storage capacity materials; polymeric composite for CSP structure. Evaluate the benefits of IN-POWER materials compared with reference materials. Evaluate the benefits of IN-POWER CSP architecture compared with current mature Parabolic Trough Collector technology.

TH312 Environmental impact and social influence of an Advanced Adiabatic Compressed Air Energy Storage (AA-CAES) located in Eisenerz, Austria. The case of RICAS2020 PROJECT. A. Claret, Leitat Technological Center / Sustainability Division; G. Ferrer, Leitat Technological Center / Sustainability Division; M.R. Riera, LEITAT / Sustainability Division; S. Vazquez, ACONDICIONAMIENTO TARRASENSE (LEITAT TECHNOLOGICAL CENTER) / Sustainability Division European society has a high dependency on electric power. In 2009 European Union fixed that at least 20% of EU gross final energy consumption have to come from renewable energy sources until 2020. The increasing use of renewable energy sources to produce energy has generated a worldwide challenge for the electric grid, where the peak production of energy is usually not in phase with the peak demand; the developing of large scale electric storage systems. The innovative AA-CAES developed within the RICAS2020 project can solve this problem. In a CAES the air is compressed in a storage unit when electric energy overproduction is available, and by the inverse process, is reintroduced in the grid when required in the high demand periods. Additionally, AA-CAES collects the heat produced by compression in a specific Thermal Energy Storage (TES) and returns it to the air when the air is expanded to generate power, delivering higher efficiencies via a zero CO$_2$ emissions process. RICAS2020 is being assessed under the Environmental and Social LCA, in order to define improvement measures to guarantee its sustainable performance. The scope of the LCA covers the construction and the operation stage of the AA-CAES. Regarding the construction stage are being assessed: the site excavation methods and the manufacture of materials needed for the construction of the Cavern and TES. Respect to the operation stage, the impact of machinery used (turbines, compressors, coolers) are being considered. The main goals of this assessment are to: (i) 2) Indentify which of the candidate materials involved in the construction of the Cavern and TES have the most suitable environmental profile. Preliminary results of the environmental LCA of candidate materials for TES have been obtained so far. 12 scenarios have been generated, by combining 3 different structural configurations (in the excavation container, concrete structure) and 4 different storage materials (rocks from the excavation site, gravel, alumina or silica ceramic spheres). Results have shown that worst cases are the scenarios that include alumina ceramic spheres as storage material, due to the high impact of aluminium oxide. The best scenario is the use of rocks from the excavation site without including structural material.

TH313 Upgrading wastewater treatment technologies in the framework of current renewable energy policies - an environmental assessment A. Petit-Boix, University of Freiburg / Chair of Societal Transition and Circular Economy; M. Riba-Salas, Universitat Autònoma de Barcelona / Institute of Environmental Science and Technology (ICTA); G. Villalba, X. Gabarrull, J. Rieradevall, Universitat Autònoma de Barcelona / Institute of Environmental Science and Technology & Department of Chemical, Biological and Environmental Engineering; E. Moliné, Departación de Aguas del Mediterráneo; M. Suárez-Ojeda, Universitat Autònoma de Barcelona / Department of Chemical, Biological and Environmental Engineering. A large number of wastewater treatment plants (WWTP) use anaerobic digestion to treat surplus sewage sludge, which produces methane-rich biogas. This biogas can be used for cogeneration with the ultimate goal of turning WWTPs into energy self-sufficient facilities. For this reason, current innovation projects focus on (i) improving the energy efficiency of the plant and (ii) updating the technologies used in WWTPs or proposing new processes that increase biogas production. However, we need to clearly define whether these technological updates and innovations result in net environmental benefits or generate tradeoffs. Here, renewable energy policies should align with the environmental goals of energy self-supply in order to discourage the investment in this type of infrastructure and its potential environmental benefits. Thus, we question whether upgraded or new wastewater treatment technologies generate larger environmental impacts when renewable energy policies are not favorable to the self-supply of energy through cogeneration. In this case, our study focuses on a conventional WWTP in the city of Rubí (Barcelona), which currently only removes organic matter. This facility considers an upgrade which consists in a new wastewater treatment scheme, i.e., (i) a first stage of a completely enhanced biological phosphorus removal and (ii) a second stage of autotrophic biological nitrogen removal in two-steps. A life cycle assessment will determine the environmental impacts and benefits of this upgraded system with respect to the conventional setup. Policy tradeoffs will also be assessed. This wastewater treatment plant originally benefited from cogeneration, but eventually decided to use biogas flare systems due to the taxes on self-supply of electricity imposed by the Royal Decree 900/2015 approved by the Spanish Parliament. As a result, we need to determine if applying technologies that generate more biogas will result in larger impacts than the current scenario if the biogas cannot be used for cogeneration.

TH314 Anticipatory life cycle assessment of sol-gel derived anti-reflective coating for greenhouse glass N. Tsoy, CML Leiden University / CML; J. Quist, Delft University of Technology / Technology, Policy, and Management; A. Wypkema, M. Mourad, TNO / Materials Solutions; V. Prado, CML Leiden University. The light transmittance of sol-gel coatings is expected to increase energy efficiency of greenhouse glass due to the glass reflection. The anti-reflective glass coatings can be applied on the surface of the greenhouse glass to allow more sunlight to enter the greenhouses. As a result, more yield of crop could be obtained under coated glass. The Netherlands Organization for Applied Scientific Research (TNO) is developing a novel anti-reflective coating for greenhouses which is expected to have higher light transmittance than the conventional coatings by 2.5%. In this study, three reference coatings in addition to the novel coating were assessed. The functional unit was the mass of tomatoes obtained under a certain area of greenhouse glass coated with uncoated/coated glass during 30 years. The novel coating is being synthesized in the laboratory scale, and thus, in LCA, What-if scenarios were used to scale-up the coating system to pilot and industrial scales. The laboratory parameters, e.g. the amount of electricity used to produce the coating and the solution volumes, were optimized using literature and expert consultation. The comparative analysis was done using the main goals of the LCA and the impacts of the coating were: (i) direct, that is, the impact of the coating production; (ii) indirect, that is, the impact of machinery used; (iii) emissions process, that is, the impact of machinery used and machinery used; and, last but not least, in the process analysis stage for the production of coating and solution. The expected results are to: Obtain a complete environmental profile of anti-reflective coating for greenhouses which is expected to have higher light transmittance than the conventional coatings by 2.5%.

TH315 Combined process simulation analysis with Life Cycle Assessment method in polyurethane rigid foam production A. Bordignon, M. Fermeglia, Universita di trieste; A. Bortoluzzi, S. Rondinini, C. Locatelli, A. Vertova, Università di Milano Process simulation is a computational technique used in several sectors of process engineering. It is very useful at design stage, for defining the feasibility of a new process, as well as in the process optimization stage, where the optimum value of the process is pursued and, last but not least, in the process analysis stage for understanding the potential improvement of an existing process. It consists in the coupling of computer simulation (using an explorative approach) and the physics and the thermodynamics of the process as well as the material and energy balances of the unit operations involved. The Life Cycle Assessment is a methodology aiming at assessing the whole life cycle of products, processes or service. In this work, we will present the analysis of the complete life cycle of polyurethane rigid foam from cradle to grave in tight connection with process simulation methods, thus bringing the characteristics of the conventional production process, such as pressure drop, energy consumption and other, with impact assessment. This combination will allow us to identify the best solution for the production of polyurethane rigid foam both in terms of life cycle and environmental impact.

TH316 Life Cycle Assessment of CO2-based Methanol Production using Captured CO2 from Fossil Fuel Power Plants C. Lee, University College London / Department of Chemical Engineering; R.
 Advancing the Adverse Outcome Pathway Framework - An International Horizon Scanning Approach (P)

TH317

Z.P. Pandelides, University of Ontario Institute of Technology; M. Overturf, University of Louisiana at Monroe / Biology; E. Ussery, University of Ontario Institute of Technology / Biological Sciences; J. Duchardi, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; D.A. Holdway, University of Ontario Inst. of Tech / Science

Embryotoxicity testing is a high throughput alternative to using the whole fish model. Previous studies in our laboratory have demonstrated that embryonic exposure to pharmaceutical compounds capable of disrupting the endocrine system such as 17α-ethinylestradiol, levonorgestrel and diclofenac, both alone and in mixtures, can impair swim bladder inflation of Japanese medaka (Oryzias latipes). Failure of swim bladder inflation can have serious long-term effects on fish populations and is an important indicator of aquatic toxicity. Embryonic exposure to xenobiotic compounds are able to cause swim bladder inflation is not fully understood; however, it is possible that compounds are able to cause their effects through a disruption of embryonic cell signalling pathways. The canonical Wnt pathway plays a crucial role in fish swim bladder development, and the disruption of Wnt signalling during swim bladder organogenesis could lead to improper swim bladder formation. The effects of two Wnt modulators IWR1 and lithium exposed from 36-101 hours post fertilization on gene expression of medaka embryos was determined. The effects of embryonic exposure to the three pharmaceutical compounds on whole embryo gene expression were then established and compared. It was measured that these pharmaceutical compounds significantly inhibited the expression of genes related to the formation of the three layers of the swim bladder (epithelial, mesenchyme, and outer mesothelium). Both levonorgestrel and 17α-ethinylestradiol also significantly downregulated the expression of lef1 and tcfl1 (β-catenin/Wnt transcription factors), but not the expression of the Wnt ligand wnt5b. Thus demonstrating that these compounds may be altering swim bladder inflation through a disruption of β-catenin/Wnt signalling during early embryo development.

TH318

Linking mode of action of the model respiratory and photosynthesis uncoupler 3,5-dichlorophenol to adverse outcomes in Lemma minor

L. Xie, NIVA - Norwegian Institute for Water Research; T. Gomes, Norwegian Institute for Water Research (NIVA) / Ecotoxicology and Risk Assessment; A. Solhaug, Norwegian University of Life Sciences; Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management; J. Moe, NIVA Norwegian Institute for Water Research; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

Lemma minor is an aquatic plant commonly used in laboratory phytoxicity testing due to its rapid reproduction capacity, resource-effective exposure format and central function in the aquatic ecosystem. Several standard methods have already been adopted by international standardization organisations using this species as an ecological model. Although being highly useful for regulatory purposes focusing on traditional and emerging contaminants, there are some gaps in the information about the toxic mechanisms and modes of action (MoA) and rarely address complex environmental issues such as exposure to multiple stressors. The present study aimed to use selected functional assays in L. minor after exposure to 3,5-dichlorophenol (3,5-DCP) as a model to characterize the toxic mechanisms caused by growth inhibition and lethality in primary producers. The results demonstrated that 3,5-DCP caused concentration-dependent effects in chloroplast and mitochondria. Endpoints such as uncoupling of oxidative phosphorylation (OXPHOS), chlorophylls content, reproduction rate and front size are more sensitive to 3,5-DCP compared to other responses as well as reactive oxygen species (ROS) formation, lipid peroxidation (LPO) and impairment of photosynthesis efficiency. Principal component analysis (PCA) indicated that suppression of photosystem II (PS II) efficiency, electron transport rate (ETR), ROS production and LPO, pigments content and growth were strongly correlated while inhibition of oxidative phosphorylation (OXPHOS) which was more closely correlated with growth parameters. A set of conceptual Adverse Outcome Pathways (AOPs) were developed by using Bayesian network model to decipher the causal relationship between stressor and responses. A set of key endpoints occurring in L. minor to form a basis for future studies with similar compounds.

TH319

Development of adverse outcome pathways for oxidative stressor-mediated reproductive effects in aquatic invertebrates

Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management; L. Xie, NIVA - Norwegian Institute for Water Research; Y. Lee, Norwegian University of Life Sciences; F. Lyne, Newcastle University; Y. Kasaraju, D.A. Brede, Norwegian University of Life Sciences / Centre for Environmental Radioactivity; T. Gomes, Norwegian Institute for Water Research (NIVA) / Ecotoxicology and Risk Assessment; G. Caldwell, Newcastle University; K. Tollefsen, Norwegian Institute for Water Research

Oxidative stress is a common type of stress in living organisms and induced when the production of reactive oxygen species (ROS) overwhelms the endogenous antioxidant defenses. Exogenous toxicants such as ionizing radiations as prototypical stressors. A network of conceptual AOPs for ROS-mediated reproductive effects in aquatic invertebrates based on existing data from the literature; assess the weight of evidence (WoE) of the AOPs relationships between molecular, cellular, and apical adverse outcomes, such as aquatic invertebrates, the knowledge is still limited. The present study was therefore conducted to: develop AOPs for ROS-mediated reproductive effects in aquatic invertebrates based on existing data from the literature; assess the weight of evidence (WoE) of the AOPs. The laboratory studies clearly showed that both UVB and gamma radiation caused dose-dependent reduction in reproduction after the exposure. The reproductive effects were correlated with excessive ROS production, lipid peroxidation, DNA damage, apoptosis, mitochondrial membrane potential and lipid storage, and abnormal ovary structures and oogenesis in D. magna, thus verifying several KEs in the conceptual AOPs. This study has for the first time systematically linked excessive ROS production to reproductive effects in aquatic invertebrates using the AOP concept, thus providing mechanistic knowledge for future hazard and risk assessment of oxidative stressor-mediated adverse effects in ecologically relevant species.

TH320

Development of an Adverse Outcome Pathway for cardiotoxicity mediated by the blockade of L-type calcium channels

L. Margiotta-Casaluci, H. Dusza, I. Moreira, Brunel University London / Institute of Environment, Health and Societies; M.J. Winter, The University of Exeter College of Life and Environmental Sciences; H. Prior, National Centre for the Replacement, Refinement and Reduction of Animals in Research (N3CRs)

A diverse set of chemical compounds, including some pharmaceuticals and...
insecticides, have the potential to perturbate the functionality of calcium channels. Among the different types of calcium channels, the L-type calcium channel (LTCC) is responsible for the excitation-contraction coupling of skeletal, smooth, and cardiac muscle. Chemicals that unintentionally block this channel in cardiac cells may impair heart function and health, leading to various cardiac pathologies and predisposing individuals to heart failure. Advancing our understanding of the mechanisms underlying these adverse effects is of paramount importance if we want to develop effective strategies able to accurately predict the cardiac risk posed by chronic exposure to those chemicals. In this presentation, we describe the development of an Adverse Outcome Pathway (AOP) that outlines the series of causally related key events triggered by the blockade of LTCC, and that can ultimately lead to cardiac adverse effects. We discuss the integration of in silico, in vitro, and in vivo evidence to support the AOP development, as well as the application of computational and network biology approaches that may accelerate the identification of relevant key events. Considering the multifaceted role of LTCC in different components of the cardiovascular system other than the heart, we also discuss the importance of applying AOP network considerations to guide a reliable and fit-for-purpose AOP development. This AOP will represent a valuable knowledge base able to guide the identification of key events that are highly predictive of in vitro toxicity, and that can be measured in vitro without relying on animal testing. The knowledge base will also be used as platform to drive future development projects aimed at incorporating additional layers of complexity in the model, and at driving the transition towards a fully quantitative AOP able to effectively support regulatory decision-making and risk assessment.

**TH321 Quantification of AOP by Bayesian network modelling: linking 3,5-DCP exposure to adverse outcomes in Lemma minor**


AOPs has gained international recognition as a systematic approach for capturing existing toxicological knowledge to transparently link mechanistic data to toxicity endpoints. Nevertheless, most AOPs are qualitative and not directly suitable for quantitative risk assessment. Quantitative AOPs (qAOP) should define the relationships underlying transition from one KE to the next sufficiently well to allow quantitative prediction of the probability or severity of the AO occurring for a given activation of the MIE. We have started developing a Bayesian Network (BN) model to quantify a recently proposed AOP, which links the mode of action of the model respiratory and photosynthesis uncoupler 3,5-dichlorophenol (DCP) to adverse outcomes in the aquatic plant Lemma minor. The BN model is based on data from a laboratory experiment exposing L. minor to DCP in 8 concentrations with 3 replicates. The measured response variables include OXPHOS (oxidative phosphorylation), ROS (reactive oxygen species), ETR (electron transfer rate), Fv/Fm (maximum quantum yield of photosystem II), LPO (lipid peroxidation) and number of fronds (leaves). The proposed AOPs a network consisting of three chains with the same chemical stressor (DCP) and AO (fronds number). All AOP components are defined in the BN as nodes with discrete states. Each node is quantified by a probability distribution across these states. The causal links (Key Event Relationships) are quantified as conditional probability tables (CPTs), which determine the probability distribution of a child node conditionally on the probability distribution of the parent node(s). The CPTs are calculated directly from the AOP network and inspecting the changes in all subsequent nodes. Qualitatively, the model predictions were as expected: increasing the DCP concentration caused reduced OXPHOS, reduced ETR and reduced fronds number. For example, when DCP was increased from 1 to 2 mg/L, the probability of fronds number being in the lowest (worst) state increased from 6% to 30%. Fine-tuning of the intervals of some nodes is needed to make the BN more responsive. Moreover, we will use statistical approaches to obtain more credible CPTs, such as estimation of dose-response curves with uncertainty. Other planned developments include linking the AO to an endpoint with regulatory relevance, and linking the chemical stressor to an Aggregate Exposure Pathway.

**TH322 Development of Quantitative Adverse Outcome Pathway (AOP) of Pulmonary Fibrosis with Effectopedia**

**J. Jeong**, University of Seoul; **N. Chatterjee**, University of Seoul / Environmental Engineering; **S. Choi**, University of Seoul / Environmental Engineering; **J. Choi**, University of Seoul / School of Environmental Engineering

Pulmonary fibrosis (PF) is a chronic and progressive lung disease where the scars are formed in the lung tissues and the air sac in the lungs (alveoli) becomes stiff. As a consequence, the alveoli lose their ability to exchange oxygen and carbon dioxide, leading to respiratory problems and potentially causing death. The application of quantitative AOP (qAOP) which provide dose-response and time-course prediction, has been gaining much more attention in regulatory decision-making field. To develop the AOP of pulmonary fibrosis, in one hand, we made preliminary AOP from literatures, which constitutes the PPARγ interaction as Molecular Initiation Event (MIE), Collagen activation, Inflammation and EMT-Fibrosis activation as Key Events (KEs), and Cytotoxicity/Apoptosis and Fibrosis as Adverse Outcome (AO). On the other hand to make qAOP, we conducted cytotoxicity and apoptosis test using human bronchial epithelium cell (Beas2B). Beas2B cell was exposed to CNT (a biocide which possess potential toxicity) in different conditions: at mid to high concentrations. Meanwhile, quantitative analysis of resulting data was used to test the hypothesis that qAOP model with the network between MIE-KEs-AO is more accurate. To verify this hypothesis, we plan to develop a qAOP model with the network between MIE-KEs-AO. Acknowledgement: This work was supported by a grant from the Korean Ministry of Environment through ‘Environmental Health R&D Program’ (2017001370001).

**TH323 Exploring Potential of Knowledge Databases for Adverse Outcome Pathway Discovery**

**C. Lai**, University of St. Thomas / School of Engineering; **Y. He**, University of St. Thomas / School of Engineering; **D. Martinovic-Weigelt**, University of St. Thomas / Biology

Adverse outcome pathways (AOPs) have potential to support and enhance the use of mechanistic data in regulatory decision-making. AOPs organize existing knowledge about relationships (ideally causal ones) between initial chemical-biological interactions (molecular initiating events; MIEs), intermediary key events (KEs), and adverse outcomes (AOs) relevant to risk assessment. Efficient ways of AOP development and weight of evidence assembly are lacking. This study evaluated potential of the existing knowledge databases (Unified Medical Language System - UMLS, and National Library of Medicine – NLM) for AOP discovery and development. UMLS contains more than 68-million relationships among more than 3-million unique biomedical concepts (or terms). The NLM literature database contains more than 100-million relationships among similar 3-million biomedical concepts extracted from the abstracts of more than 16 million biomedical journal papers. First, AOP network was downloaded and parsed from AOP Wiki (https://aopwiki.org). We found that there are 3,084 relationships among stressors, MIEs (main initial events), KEs (key events), AOs (adverse outcome), stressor-chemicals, and stressor-events. High performance graphic processing unit (GPU) was used to determine which of 3,084 relationships can be found in hundred million of relationships in UMLS and NLM databases. 610 (20%) relationships were found in the UMLS database. About 1,837 (60%) relationships were found in the abstracts of 16 million biomedical papers on NLM. When combining our searches over both the UMLS and NLM databases, 1,983 (64%) relationships from AOP wiki were found; relationships in some sub-categories such as stressor-chemicals had much higher hit ratio - 79%. These findings indicate that AOP-discovery system that uses UMLS and NLM to predict new probable AOP relationships (that can connect to objects in the AOP Wiki) could substantially accelerate AOP development and contribute to weight of evidence analyses. The confidence of the predicted relationships could be calculated based on frequency of the relationships, whereas the quality of the predicted relationships could be further improved by training deep learning models with knowledge curated in databases such as The Comparative Toxicogenomics Database, ECOTOX and iCSS ToxCast Dashboard.
MOPC01
Fish caging experiment as a tool for in situ assessment of neurotoxic effects of untreated wastewaters
B. Mičić, Petnica Science Center/Faculty of Sciences, University of Novi Sad / Department of Biology and Ecology; D. Tenji, University of Novi Sad Faculty of Sciences / Biology and Ecology; S. Sipos, Faculty of Sciences University of Novi Sad / Department of Biology and Ecology; V. Knezevic, Faculty of Sciences / Department of Biology and Ecology Laboratory of Ecotoxicology LECOTOX; S. Kaisarević, Faculty of Sciences University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology (LECOTOX); I. Teodorovic, University of Novi Sad / Department of Biology and Ecology, Laboratory of Ecotoxicology (LECOTOX)
In the framework of FP7 project Solutions, the city of Novi Sad has been selected as a pollution hot spot of the River Danube, mainly due to the direct discharge of untreated sewage into the river. Significant biological effects of untreated sewage were previously observed through an in vitro study. To study neurotoxic effects more in details and in realistic ecological context, we conducted fish caging experiment. Common carp (Cyprinus carpio (L.), Cyprinidae) was selected for the experiment, as one of the most common species in the Middle Danube, geographically well described and economically important. Ten fish per cage were exposed in cages for nine days at three sites on the Danube River: upstream from sewage discharge – reference site, 230 m and 7 km downstream from the discharge and at one site on Sava River (downstream from industrial wastewater discharge near the city of Sabac). After the exposure period, brains were isolated and prepared for gene expression and enzyme activity analyses. The expression of genes encoding for five neurotoxicants was studied: tachykinin 3a and tachykinin 3b (involved in neuroendocrine regulation of reproduction), GABA a1 receptor (for the inhibitory neurotransmitter GABA and various drugs), synaptotagmin 10 (integral membrane protein of synaptic vesicles with a role in exocytosis) and myelin basic protein (responsible for myelination of axons and neuroprotection). The activity of acetylcholine esterase, enzyme that terminates action potential transmission in chemical synapses of cholinergic type, was also examined. A trend of slight upregulation for the expression of the genes encoding for tachykinin 3a and tachykinin 3b, GABA a1 receptor and synaptotagmin 10 was observed for all three studied sites when compared to the reference site. The expression of the gene encoding for myelin basic protein was similar at reference site and 230 m downstream from the sewage discharge, but this gene expression was significantly downregulated downstream from the industrial wastewater discharges. Based on this result, myelin basic protein might be potential selective biomarker which can be used to differentiate the effects of these two types of chemical pressure. No significant difference was observed in the activity of the acetylcholine esterase between studied sites. The study is part of the SOLUTIONS project, funded by the EU FP 7 (FP7-ENV-2013-two-stage Collaborative project) under grant agreement number 603437.

MOPC02
Toxicity analysis of treated sugar cane vinasse by integrated systems using gills of Oreochromis niloticus as model
A. Modesto, Sao Paulo State University - UNESP / Department of Biology; C.P. de Souza, Sao Paulo State University - UNESP / Biology; J. Evangelista Correia, Unesp - Institute of Biology / Biology; C.S. Fontanetti, Sao Paulo State University - UNESP / Biology
The alcoholic fermentation of sugar cane (Saccharum sp.) results in a by-product known as vinasse. This by-product is used as fertilizer because of its richness in organic matter, and also because it promotes improvement in soil fertility, favoring the availability of some elements for the plants. However, the amount of vinasse used in the fertirigation should not overcome the ion retention capacity of the soil, since the dosages should be directed to the specific characteristics of each soil. When used in unbalanced proportions can impair to the soils and the plants, in addition to being able to reach water resources. Considering studies that prove the toxicity of vinasse in nature, the use of treatment systems has become quite interesting. The integration of systems such as natural attenuation, filtration and phytoremediation increase the effectiveness of the treatment, since they are highly effective biogeochemical systems to treat waste water from different sources. Aquatic macrophytes, which not only accumulate pollutants directly in their tissues but also act as catalysts for purification reactions that usually, occur in the rhizosphere of plants, they are part of the alternative treatment for vinasse. Fish are excellent experimental models for aquatic toxicity studies because they warn of the potential danger of chemicals reaching water resources. Therefore, this study aimed to verify the efficacy of sugar cane vinasse treatment in reducing its toxic potential by histological and histochemical tests on tilapia gills. The animals were submitted to two different dilutions of the treated vinasse for 96 hours; after this period the gills were removed and submitted to standard histological routine. Morphological analyses of the gills revealed that the cellular pattern described for the species was not altered and histochemical tests showed a decrease on number of nuccous cells, thus attesting to the decrease on toxicity of the treated vinasse. Thus, it can be inferred that integrated treatment systems were effective in reducing the polluting potential of vinasse, since the animals did not present histological changes.

MOPC03
Assessing toxic effects in the fish Violet Goby (Gobiobius broussonneti - Gobidae) from one of the most productive estuaries in Brazil
L. Salgado, Universidade Federal do Paraná / Farmacologia; A.M. Maques, UFPR / Genetics; F. Garrido de Oliveira, UFPR / Pharmacology; S.L. Moretto, M.M. Cestari, UFPR / Genetics; H. Silva de Assis, UFPR / Pharmacology
The Matapuque-Lagoon Goby (Gobioides unzai-Cananeia (Sao Paulo, southeast Brazil) is among the most productive areas in the South Atlantic. The Ribeira de Iguape River (RIR) is the major freshwater contributor of the estuary. It carries different classes of contaminants from former mining activities, agricultural areas and urban centers through an artificial channel. The disordered human occupation, presence of boats and the disposal of waste and sewage are also sources of pollution throughout this system. The Violet Goby (Gobiobius broussonneti - Gobidae) is a demersal fish of a social and economic importance to traditional fisheries. Over the last decade the regional disappearance of this fish species has been reported, including events of high mortality. The contamination by the RIR has been referred as one of the causes of the decline of that population. Therefore, this study aimed to observe possible toxic effects in G. broussonneti the studied area. Fishes were sampled near Cananéia, Subaúma and Iguape in winter (2016) and summer (2017). The animals were anesthetized, euthanized and the blood, brain, muscle, liver and kidney were collected for the biochemical and genetic biomarkers analysis. The muscle AChE activities showed similar results among the points and seasons, while cerebral AChE were lower in Subaúma in winter. Hepatic and renal GPs and GST activities, GSH concentrations and LPO damage in liver were similar. However, it was observed gonotoxicity indices and hepatic lipid peroxidation in liver and blood in summer. In winter, nuclear morphology alterations were identified in erythrocytes more frequently in fishes of Cananéia. The results suggest that contaminants such as metals and HPAs previously reported in the sediments may have been stressing this species. The marked seasonality of the region, which consequently influences the temperature, the rainfall regime and the bioavailability of contaminants may interfere in the responses. Non expressed anionic activity was observed near to Cananéia and Subaúma points. It suggests an influence of the local hydrodynamics by dragging the contaminants of the main sources (RIR and Cananéia city) to these areas once lower impacts were seen in Iguape. This last point is located above the artificial channel in an area of low hydrodynamic. Water and sediment chemical analyzes are being performed in the studied points in order to support a better understanding of these responses.

MOPC04
Does ozonation of the Aachen-Soers WWTP improve the water quality in the field? Caging experiments with juvenile rainbow trout and various bioindicators
Y. Mueller, RWTH Aachen University / Department of Ecosystem Analysis ESA; T. Rosenberger, RWTH Aachen University / Institute for Environmental Research BioV; S. Schiwi, Institute of Environmental Research-RWTH Aachen / Department of Ecosystem Analysis; H. Hollert, RWTH Aachen University / Institute for Environmental Research
This study on Water Fruits was a prospective aimed to achieve a good chemical and biological state of all surface waters until 2015. However, the good biological state is only reached by around 20 % of the German surface water bodies. One reason might be the release of a variety of anthropogenic contaminants by waste water treatment plants (WWTPs) into these water bodies. Additionally, these substances are not sufficiently eliminated via conventional waste water cleaning processes. Nevertheless, these chemicals can have adverse effects on the river biota. The implementation of a further treatment step into WWTP could reduce this burden. There are advanced treatment processes, as the ozonation. At the “Aachen Soers” WWTP a large-scale ozonation plant was installed at the end of 2017. Regular operation will start by approximately March 2018. The “Aachen Soers” WWTP is located near the city of Aachen and extends over a larger area (North-Rhine Westphalia, Germany) and releases its effluent to the Stream Wurm. At medium and low water levels the stream runs around 70 % treated waste water. To elucidate the impact of the additional waste water treatment on this river the status quo was recorded before the implementation of this treatment step. After the installation of the ozonation the WWTP as well as the Wurm will be monitored for two years. Besides numerous in vitro and in vivo experiments also in situ conducted experiments with juvenile rainbow trout (Oncorhynchus mykiss) were performed upstream and downstream the WWTP. The goal was to evaluate the impact of the WWTP outlet on the river. Further, the impact of the upstream burden was part of the study. Several biomarkers were investigated on different organs of the fish. Detoxification enzymes were investigated in liver tissue and acetylcholinesterase was measured in brain tissue. Furthermore, microcilia formations counted in blood smears get information on genotoxic effects. To gain information on endocrine effects Vitellogenin levels were measured in blood plasma and mucus to compare the conventional invasive method with a new non-invasive method. Fish were caged
during late summer in 2017 to evaluate the status quo of the stream and the performance of the “Aachen Soeris” WWTP. This project is funded by the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of North Rhine-Westphalia.

**MOPC05**

Environmental applications for medium-throughput, in vivo androgen disruptor identification with the RADAR assay

A. Tindall, A. Phan, N. Roxane, Watchfrock S.A.; B.A. Demeneix, MNHN / CNRS UMR 7221; G.F. Lemkine, Watchfrock S.A.

Over recent years, it has become evident that environmental contamination with endocrine disruptors is not limited to those acting on the estrogen axis. In contrast, large-scale effects of chemicals that have been identified with in vitro models. Two key studies identified 66/200 and 37/134 pesticides tested as anti-androgenic. However, due to the absence of medium-throughput in vivo assays for androgen axis disruption, the effects of many of these pesticides have yet to be confirmed in vivo. We developed a transgenic medaka line harbouring a portion of the sogiel gene promoter driving expression of GFP. We have previously demonstrated that this line is capable of correctly identifying androgens and anti-androgens, including pesticides, with similar sensitivity to the androgenised female stickleback screen but in a greatly reduced time frame. Using eleuthero-embryonic life stages we developed the Rapid Androgen Disruption Adverse outcome Reporter (RADAR) assay. Extracts of Danube River water from sites upstream and downstream from a major effluent stream from the city of Novi Sad in Serbia was analysed. Comparison of our results to previously published data from four in vitro assays carried out on the same extracts indicated that the effect observed in vivo was two orders of magnitude higher than the in vitro effect, suggesting additional mechanism(s) of action present in vivo in addition to androgen receptor activation indicated by the in vitro assays. Application of the RADAR assay for effect-directed analysis was demonstrated for the rapid in vivo confirmation of chemical identities of number of pesticides already identified by screening with in vitro models were also tested. The anti-androgenic effects of these pesticides had not previously been confirmed in vivo to our knowledge. Powerful anti-androgenicity was observed with the RADAR assay for some of the tested pesticides, confirming the results of the in vitro study. The RADAR assay is a reliable medium-throughput tool which can be applied within a variety of environmental scenarios in order to identify androgen axis disruption, such as environmental monitoring, identification of unknown toxicity drivers and testing of pure chemicals in a REACH context. In addition, this model, based on the use of early life stages non-compliant with the EU definition of a laboratory animal, provides ethical advantages in line with the three R’s principle of animal replacement.

**MOPC06**

Evaluation of the toxicity of environmental samples collected near vineyard parcels on rainbow trout larvae (Oncorhynchus mykiss) and liver cell line RTL-W1

S. Weeks Santos, EPOC University of Bordeaux; P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; J. Grussou, EPOC University of Bordeaux / UMR EPOC; Q. Papin, University of Bordeaux / UMR EPOC; C. Clérandeau, EPOC University of Bordeaux / EPOC UMR; B. Morin, University of Bordeaux / EPOC; B. Cormier, Université de Bordeaux / EPOC UMR; P. Gourves, University of Bordeaux / UMR EPOC CNRS 5805; J. Cachot, University of Bordeaux / EPOC VITI; G. Balakrishnan Nair, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry; G. Ivleva, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry; L. Prechtl, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry; M. Elsner, N.P. Ileva, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry.

On the one hand, plastics are a most important part of our daily life. Due to their versatile properties, especially their low weight, formability and their low costs they are an ideal packaging material. [1] On the other hand, microplastics (MP) are for example frequently found as resulting from new applications for medium-throughput in vivo androgen disruptor identification with the RADAR assay.

**MOPC07**

Optimization and Automation of Raman Microspectroscopy for Microplastic Analysis

P.M. Anger, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry; L. Prechtl, Technical University of Munich / Institute of Hydrochemistry; R. Niessen, Technical University Munich / Chemistry Department, Chair of Analytical and Water Chemistry; M. Elsner, N.P. Ileva, Technical University of Munich / Chemistry Department, Chair of Analytical and Water Chemistry. 

Pollution with plastic debris and plastic fragments has recently been recognized as a major water quality problem in fresh and marine water systems. Degradation of plastic debris in the marine environment leads to the formation of microplastics (< 5mm) and potentially nanoplastics (< 1 µm). Recent investigations show that the microplastics can interact with the marine biota. The impact of the interaction on the exposed organism depends on the nature and size of the particles. To acquire more knowledge on these impacts and to optimize analytical procedures, model particles of different sizes and nature of polymers are necessary. However, in the smallest range (< 10 µm), particles of only a few types of polymers are currently available. For this reason, most toxicity tests were realised using PS beads whereas polyethylene (PE) and polypropylene (PP) fragments are by far the most common in the aquatic environments. In addition, commercial micro and nanobeads have surfactants at their surface which may enhance their toxicities. Here, we present a simple methodology that allows one to prepare small microplastics of PE with sizes between 0.7 µm to 3 µm. These particles were obtained by dissolving PE pellets in toluene at high temperatures, then was emulsified in water and ultrasonication. After removal of the solvents particles were recovered as powders that could be re-dispersed in water. Besides providing particles of small size, the advantage of the presented methodology is that it is possible to produce these particles without any surfactant. However, to obtain significant yields it is necessary to add a surfactant. Several types of surfactants were tested (Tween60, Tween80 and a biosurfactant obtained from an algae culture). The effect of each surfactant on the size, shape and stability of the particles will be discussed.
MOPC9
Effects on humming substances and sediments on the sorption of anthropogenic chemicals to different MP particles
S. Hopensterg, V. Zilles, Hochschule Fresenius University of Applied Sciences; T. Knepper, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology
Plastic products are nowadays omnipresent as they possess excellent characteristics as raw materials. An increased production and usage of plastic products in the last decades led to an emerging pollution of the environment. Slow or no biodegradable facilities contribute to a vector of accumulation of plastic materials in the environment. Plastics can be found in various sizes in the environment, large items were found as well as small particles or debris, which are referred as microplastic (MP) in a size range from 5 mm to 1 µm. In aquatic environments organic pollutants may sorb to MP, which can act as vectors for the sorbed pollutants. It is assumed that polymer material, characteristics of the sorbate, embrittlement of MP-particles, biofouling, and availability of sorption sites contribute to the sorption. Humic substances are a complex mixture of breakdown products of biologic matter, regarding about 50% of dissolved organic in surface waters. The composition and structure of humic substances are not yet fully elucidated due to their heterogeneity. Humic substances contain a high number of electron donors, which can interact with many natural and anthropogenic substances. Sediments coated with humic substances and rubber particles with rubber particles do not contribute to the sorption of organic pollutants as majorities of them sorbs to sediment which is present in excess. The results of this study should provide a tool for predicting sorption behavior of MPs in environmental freshwater samples. Therefore, different parameters presumably affecting the sorption were investigated or are still under investigation to identify their impact on the sorption of organic pollutants in freshwater systems.

MOPC10
Micronized tire rubber: abundance and distribution within microplastic litter of the Charleston Harbor Estuary, South Carolina, USA
R. Leads, College of Charleston / Biology; J.E. Weinstein, The Citadel / Department of Biology
Microplastics (2µm present on shorelines worldwide. A previous survey of Charleston Harbor, South Carolina, USA reported an average of 591±105 microplastic particles/m3 in intertidal sediments, with black fragments suspected to be micronized tire rubber making up >90% of the particles at some sites. The objective of the present study was to first characterize the abundance and distribution of microplastics, and in particular, micronized tire rubber, in an effort to identify the sources and pathways into Charleston Harbor. As rivers are thought to be a contributor of non-point and point source microplastics, three major tributaries of Charleston Harbor—the Ashley River, Cooper River, and Wando River—were surveyed. Intertidal sediment (n=6), subtidal sediment (n=3), and sea surface microfloc (n=3) samples were collected from three sites (upstream, midstream, downstream) along each of the rivers and were analyzed for microplastics (65-500 µm). Intertidal sediment microplastic abundance ranged from 3-4375 particles/kg wet weight. Surface sea microfloc microplastic abundance ranged from 3-36 particles/L. Microplastic abundance in intertidal sediments and subtidal sediments differed significantly among rivers (p<0.0001 (intertidal), p=0.02 (subtidal)), while microplastic abundance in the sea surface microfloc did not differ significantly among rivers. Blue microplastic fibers and micronized tire rubber were the most abundant types of microplastics observed, constituting 26.2% and 17.1%, respectively, of total microplastics collected. Furthermore, micronized tire rubber was collected at every sampling location and in every size of ~10 µm. Electron microscopy suffers from sampling issues and high mortality rates were found for different marine zooplankton species.

MOPC11
Crumb rubber in sports fields - Advancements in environmental chemistry
D. Herzke, NILU - Norwegian Institute for Air Research / FRAM Centre Tromsø; C. Halsband, Akvaplan-niva; L. Sirensen, A. Booth, SINTEF Ocean / Environmental Technology
In Norwegian coastal communities, rubber microplastic granules (<5 mm in size) derived from discarded vehicle tires are used in large quantities on outdoor synthetic turf sports pitches. Through transport by waste water effluents and terrestrial runoff, these rubber particles are considered a significant source of MPs to the marine ecosystem. In the here presented interdisciplinary project we study the composition, degradation, and ecotoxicological impacts of these rubber granules from locations in northern Norway and Svalbard. Their persistence and residence time in the Arctic marine environment is unknown. These rubber particles pose a potential health risk for arctic wildlife through direct ingestion, especially at the base of the marine food chain, but may also provide an exposure route for toxic additive chemicals present in tires to marine organisms. Furthermore, the rubber particles may act as a vector for other persistent organic and heavy metal pollutants already present in the marine environment. Arctic marine environments present special abiotic conditions for the degradation of these particles, with cold water temperatures and long periods with unlimited sunlight. During a 12 months period, rubber crumbs were placed out in the ocean in stainless steel containers and sub-sampled continuously for the measurement of persistent organic pollutants, metals and additives. Hydrophobic persistent organic pollutants such as PAHs, PCBs, DDTs, bisphenols, as well as metals were measured to establish the adsorption and leaching kinetics in seawater under in situ conditions. Samples were extracted using ultrasound and nonpolar solvents, followed by GC and SPE clean up. Chemical analyses using pyroGC/MS, GC/MS/MS and LC/HRMS were done in the laboratories of NILU, Tromsø and SINTEF, Trondheim. Exposure to demonstrate the detection of nanostructures in environmental matrices and their ecotoxicological effects are matters of intensifying research. A significant amount of these particles is generated by degradation and fragmentation processes of larger marine litter. Although experimental proof is scarce, it can be assumed that fragmentation does not stop at the macro scale. This hypothesis is supported by results of our group that were obtained from various environments (e.g. North Sea sediments and arctic ice). A mathematical extrapolation of size dependent particle abundances in the samples returns abundances of up to 3.6 x 10^6 kg^-1 for particles with diameters of 0.5 µm. This circumstance raises concerns as particles have a very low opportunity to be detected by currently available technology. With imaging FTIR this is possible only down to particle sizes of ~10 µm. Electron microscopy suffers from sampling issues and high mortality rates were found for different marine zooplankton species.

MOPC12
Novel nano-FITR analysis with Nano-FITR
M. Meyns, Alfred Wegener Institute; S. Primpke, G. Ger dés, Alfred Wegener Institute / Shelf Sea Ecology
The distribution of microplastic particles in marine environments and their ecotoxicological effects are matters of intensifying research. A significant amount of these particles is generated by degradation and fragmentation processes of larger marine litter. Although experimental proof is scarce, it can be assumed that fragmentation does not stop at the macro scale. This hypothesis is supported by results of our group that were obtained from various environments (e.g. North Sea sediments and arctic ice). A mathematical extrapolation of size dependent particle abundances in the samples returns abundances of up to 3.6 x 10^6 kg^-1 for particles with diameters of 0.5 µm. This circumstance raises concerns as particles have a very low opportunity to be detected by currently available technology. With imaging FTIR this is possible only down to particle sizes of ~10 µm. Electron microscopy suffers from sampling issues and high mortality rates were found for different marine zooplankton species.

Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (PC)

MOPC17
Neonicotinoid insecticides in surface waters discharging into the Great Lakes of Southern Ontario, Canada
T. Sultana, Trent University / Environmental and Resource Studies; P.A. Helm, Ontario Ministry of Environment and Climate Change / Environmental Monitoring and Reporting Branch; C.D. Metcalfe, Trent University / Water Quality Centre
Neonicotinoid insecticides (NNIs) are a large part of the global pesticide market, as they are very effective at controlling a wide range of insect pests. In Canada, NNIs are used extensively in agricultural regions of southern Ontario to control insect pests on field and greenhouse crops, orchards, nurseries and woodlots etc. Because of their persistence and high solubility in water, there is potential for NNIs to be transported from agricultural fields into surface waters. The objective of this study was to evaluate the distribution of NNIs in surface waters located in areas of intensive agriculture in southern Ontario, Canada that discharge into the Great Lakes basin; specifically into Lake Erie. Lake Saint Clair, Lake Ontario and Lake Huron. Passive sampling with Polar Organic Chemical Integrative Samplers (POCIS) was the principal monitoring technique. To correct for the effect of environmental factors on the rates of uptake of the target NNIs into POCIS, Performance Reference Compounds (PRCs) were spiked into some of the POCIS deployed at each of the monitoring sites. POCIS were deployed for 2 weeks over two different deployment periods and grab samples of surface water were also collected three times over the deployment period. The sites monitored were located in 5 major rivers and 11 smaller creeks in the Great Lakes basin. Static, renewal
MOPC18
Occurrence and removal of antibiotics in municipal wastewater by conventional activated sludge (CAS) and membrane bioreactor (MBR) systems
N. Tran, National University of Singapore / NUS Environmental Research Institute; K. Gin, National University of Singapore / Civil & Environmental Engineering

This study provided the first and comprehensive data on the occurrence and removal of twenty-one target antibiotics and antimicrobials in a full-scale conventional activated sludge and membrane bioreactor systems in the Southeast Asian region. Nineteen out of the twenty-one target compounds were ubiquitously detected in raw influent samples. Concentrations of the detected ECs in raw influent samples ranged by several orders of magnitude (e.g. from 23.8 to 43,740 ng/L) depending upon the compound and sampling date. The elimination of antibiotics and antimicrobials in full-scale conventional activated sludge (CAS) and membrane bioreactor (MBR) systems at a local WWTP was evaluated and compared. Numerous antibiotics and antimicrobials, such as meropenem (MER), amoxicillin (AMX), ciprofloxacin (CIP), clindamycin (CLD), azithromycin (AZT), clarithromycin (CLAR), oxytetracycline (OXY), trimethoprim (TMP), tetracycline (TET), vancomycin (VCM), and chloramphenicol (CAP), were largely removed by both CAS and MBR systems. In contrast, trimethoprim (TMP), trimethoprim-sulfamethoxazole (ERYO) appeared to be persistent in both the CAS and MBR systems. Field-based monitoring results showed that MBR outperformed CAS in the elimination of most targeted antibiotics and antimicrobials. The relationship between molecular characteristics of ECs (i.e. physicochemical properties and structural features) and their removal efficiencies during biological wastewater treatment was also elucidated. Excellent removal efficiencies (>90%) were often noted for compounds with the sole presence of electron donating groups (i.e. phenolic –OH, beta-lactam ring, amine –NH2, methoxy –OCH3, phenoxo –O(CH3), or alkyl groups). Conversely, antibiotics or antimicrobials with the electron withdrawing groups or the predominance of strong electron withdrawing groups (e.g. halogenated, carbonyl, carboxyl, sulfonamide, etc.) tended to show poor removal efficiencies (<30%) in biological wastewater treatment processes.

MOPC19
The effect of activated sludge conditions on micropollutants biodegradation and transformation products formation
L. Giusmaroli, G. Buttiglieri, Catalan Institute for Water Research ICRA

Micropollutants such as pharmaceuticals (PhACs) and endocrine disrupting compounds (EDCs) have been detected in all water compartments and the European Union is therefore updating its legislation to limit the release of emerging contaminants. Numerous studies have revealed that the sorption to aquatic sediments is one of the principal processes of removal of these compounds from superficial waters, which may influence their biodegradation and bioavailability. In this study, the biodegradation of nine micropollutants (e.g. estrone, ibuprofen, flumethiazole, ibuprofen (2R,3S)-diol, oxalic anhydride, N1-ethyl-N4-butylsalicylhydroxamide) was first tested in the absence of organisms, and then biomimetic conditions were applied. The biodegradation of these micropollutants was studied in bothoxic and anaerobic conditions at different pH levels (3, 6, 8). The results showed that the biodegradation of these micropollutants was affected by the pH and, in particular, the biodegradation efficiency of some micropollutants was improved in anaerobic conditions. Thus, the results of this study suggest that future investigations on the biodegradation of micropollutants should be conducted under anaerobic conditions, which are more realistic for natural aquatic systems.

MOPC20
Ciprofloxacin By-Products in Seawater Environment in the Presence and Absence of Gilt Head Bream
H. Zarzuría, L. Mijangos, University of the Basque country UPV/EHU / Department of Analytical Chemistry; M. Izarola, University of the Basque country UPV/EHU / Research Centre for Experimental Marine Biology and Biotechnology (PIE); A. Prieto, N. Etxebarria, University of the Basque country UPV/EHU / Plentzia Marine Station (PIE-UPV/EHU) & Dep Analytical Chemistry; E. Anakabe, University of the Basque country UPV/EHU / Organic Chemistry; M. Olazar, O. Zuloaga, University of the Basque country UPV/EHU / Plentzia Marine Station (PIE-UPV/EHU) & Dep Analytical Chemistry

The widespread use of pharmaceuticals has caused a growing concern on the presence of pharmaceuticals such as the antibiotic ciprofloxacin (CIPRO) in the aquatic environment, since they may exert adverse effects on non-target organisms, including fish. In order to study the uptake, distribution in different tissues (liver, muscle, brain and gill) and biofluids (plasma and bile), metabolism and elimination of CIPRO in gilt-head bream (Sparus aurata), controlled dosing experiments for 8 days at 200 µg/L concentration were carried out. CIPRO was only observed in bile, probably due to its low octanol-water partition coefficient and the zwitterionic behaviour. CIPRO by-products (BP)s were also identified in seawater environment, both in presence and absence of fish. The analysis done by means of liquid chromatography-high resolution mass spectrometry permitted the annotation of up to 35 BPs of CIPRO in seawater and bile, from which 30 structures were reported for the first time. Up to 20 BPs were annotated in the absence of fish. The phase I degradations suffered by CIPRO in seawater were oxidation, methylation, oxidative defluorination (in 3 BPs out of 20), reductive defluorination (1 Bp out of 20), dehydrogenation of the piperazinyl ring (in 2 BPs) and the cleavage of the peptide bond in CIPRO ring with (1 BP) or without (2 BPs) the loss of the primary amine formed during the cleavage. The only phase II transformation of CIPRO observed was BP18 that, apart from the oxidative deamination of the piperazinyl ring, also suffered the glycation conjugation. 14 of the previously observed BPs were plus 10 new BPs were annotated in water in the presence of fish. Compared to the BPs annotated in the absence of fish, oxidative deamination and both glycation and glutamine conjugation gained importance since 4 of the 10 new BPs had suffered both transformation reactions. Although CIPRO metabolites were searched in gilt-head bream liver, brain, muscle, gill, plasma and bile, BPs were only detected in bile. 5 BPs were found and none of them was detected in seawater. While defluorination and oxidative deamination gained importance in bile, neither glycopeptide nor glycine conjugates were observed in bile BPs. Acknowledgments - This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56628-C3-1-R. H. Zarzuría is grateful to the Spanish Ministry and L. Mijangos to the Basque Government for their predoctoral fellowships.

MOPC21
Assessment of the occurrence and impact of polar pesticides in irrigation and drainage ditches at the Ebro River Delta cultivated area (NE Spain)
M. Barbiéri, Ins of Environ Assessment&Water Resch (IDAEA-CSIC) / Water and Soil Quality Research Group; S. Monllor, N. Guillen, Institute of Environmental Assessment and Water Research IDAEA-CSIC / Department of Environmental Chemistry; C. Posada, M. Rambla, University of the Basque Country UPV/EHU / Department of Analytical Chemistry; M. López de Alda, Institute of Environmental Assessment and Water Research IDAEA-CSIC / Department of Environmental Chemistry

The Ebro River Delta, located in northeastern Spain, is one of the largest wetland areas of the Mediterranean region. It is an area of high ecologic and economic values, where wildlife shares the territory with intensive rice growing and other agricultural activities and seafood production. The objective of this work was to investigate the occurrence of different classes of medium to polar pesticides and transformation products in irrigation and drainage ditches at the Ebro Delta in summer, when application of pesticides is more intensive in the area, and to assess the extent that these contaminants may have on local ecosystems and seafood production activities, and eventually on human health. To this end, an analytical method based on on-line solid-phase extraction-limited chromatography–tandem mass spectrometry (SPE-LC–MS/MS) was developed and validated for analysis of over 50 pesticides, including various neonicotinoid and organophosphate insecticides, as well as herbicides pertaining to the classes of triazines, phenylureas, acetanilides, sulfonylureas, chloroacetanilides, acyclic herbicides, oxadiazoles, carbamates, benzothiazinazones, nitriles, diphényl ethers, and carbamates in water. This methodology, which offers various advantages for its routine use in the analysis of medium to polar pesticides in the different water compartments, allowed the quantification of most of the target analytes at levels below 10 µg/L, and with a high reliability of results that stems from the use of an automated and highly selective analytical technique and the use of deuterated analogues of the target compounds as surrogate standards for their quantification. Bentazone followed by propanil presented the highest average concentrations in the analyzed samples, being in the µg/L level. Oxadiazon, acetamiprid, imidacloprid, and triallate were also found at

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relevant concentrations in the investigated area and time (above 100 ng/L). As expected concentrations were higher in drainage canals than in irrigation ditches. Measured concentrations were used to evaluate the ecotoxicological risk for the aquatic organisms in this area by means of a hazard quotient-based approach. This work was possible thanks to the Government of Catalonia (2014 SGR 418) and the Spanish State Research Agency (AEI) and the European Regional Development Fund (ERDF) through the project BECAS (grant number CEMT2016-75587-C2-2-R), and to Merck for the gift of LC columns.

MOPC22
Degradation kinetics and degradation products of diclofenac with persulfate J.M. Montegudo, University of Castilla-La Mancha; H. El-taliawy, Aarhus University / Department of Environmental Science; A. Durán, J. San Martin, University of Castilla-La Mancha; K. Bester, Aarhus University / Environmental Science

Diclofenac concentrations in effluent wastewater are often exceeding local limits or upcoming EU regulations. This study was undertaken to explore the possibilities of removing diclofenac with persulfate in respect to kinetics and reaction pathways. In-situ chemical oxidation of a diclofenac aqueous solution was performed using persulfate anions activated by ultrasound. The diclofenac (DCF) removal reaction by the persulfate process and the role of various intermediate oxidative species of persulfate such as hydroxyl, sulfate, superoxide anion or singlet radicals in the removal process as well as to determine a possible reaction pathway was observed. The removal efficiency was highest at pH values below 4.5. In addition, the production rate of sulfate radicals from persulfate anion was increased with decreasing pH values. A reduction in the reaction rates in the ultrasonic persulfate (US/PS) process was observed with excess persulfate as the reagent decomposed via the non reactive SO²⁻ (with no generation of the very effective SO₄²⁻). Sulfate and hydroxyl radicals were involved in the main reaction pathway of diclofenac. Diclofenac amide and three hydroxy-diclofenac isomers (3-hydroxy-diclofenac, 4-hydroxy-diclofenac and o-hydroxy-diclofenac) were identified as reaction intermediates. The obtained results demonstrated that the US/PS process could be a potential alternative to remove compounds of emerging concern, such as diclofenac from wastewater.

Mercury Biogeoosciences - Fate, Effects and Policy (PC)

MOPC23
Identifying, Characterising and Quantifying Atmospheric Mercury Sources Using Passive Air Sampling Networks D. McLagan, University of Toronto Scarborough / Chemistry; C. Mitchell, University of Toronto Scarborough / Physical & Environmental Sciences; F. Monaci, University of Siena; Y.D. Lei, University of Toronto Scarborough / Department of Physical and Environmental Sciences; F. Wania, University of Toronto at Scarborough / Physical and Environmental Sciences

The Minamata Convention on mercury (Hg) stipulates that complete emissions inventories should be established. Passive air samplers (PAS) produce averaged concentration data over long deployment periods and are therefore particularly well suited for mapping gaseous Hg concentrations, identifying and locating unknown Hg sources, and quantifying emission rates. We used networks of PAS in both the Greater Toronto Area (GTA) in Canada and the Monte Amiata Hg region in southern Italy to illustrate this approach to Hg source characterisation. We used a PAS for gaseous Hg, which incorporates a sulphur-impregnated activated carbon sorbent and a radial diffusive barrier to control uptake kinetics. 145 PASs were deployed across the GTA in July and August 2016 for time periods ranging from 34 to 46 days. In Italy, PASs were deployed at two spatial scales: a 0.56 km² square comprising the former Abbadia San Salvatore mercury mine and a 41.6 km² square covering the eastern slope of Mt. Amiata. Both squares were divided into a grid of 7x7 cells and a sampling site was selected within each of the 49 cells. The finer spatial resolution grid was sampled twice with one-week long deployments in Oct. 2015 and Jul. 6 2016. The coarser spatial grid was sampled for an extended period of 22 months. Monitoring gaseous Hg concentrations in downtown Toronto (1.77 ± 0.28 ng m⁻³) were slightly, but significantly elevated relative to other parts of the GTA (1.42 ± 0.20 ng m⁻³). Measurements at sites close to waste/recycling (1.61 ± 0.22 ng m⁻³) and hospitals/dental facilities (1.63 ± 0.21 ng m⁻³) were significantly higher than at sites presumably distant from potential sources (1.37 ± 0.20 ng m⁻³). In the mine area in Italy concentrations reached as high as 12,500 ng m⁻³ and declined rapidly with distance from the most contaminated site. Concentrations were higher in July than in October. At both spatial scales, concentrations declined less steeply towards the East, consistent with prevailing westerly winds. Atmospheric emission from the mine was estimated to range from 50 to 100 kg annually. Clearly, the PAS’s ability to precisely and accurately discriminate small differences in gaseous Hg concentration (< 0.2 ng m⁻³) across a wide range of concentrations, including at and near global background levels, enables the mapping of the spatial concentration variability and the identification, characterisation and quantification of both fugitive and major Hg emission sources.

MOPC24
Mercury trend as a possible result of changes in cod age distribution A. Raus, NIVA / NIVAD; D. Hjernman, NIVA Norwegian Institute for Water Research; B. Belych, NIVA; M. Schøyen, S. Øxnevad, NIVA Norwegian Institute for Water Research; N. Green, NIVA

Mercury (Hg) enters the biosphere from natural and anthropogenic sources. Methylmercury is the most toxic form of Hg and has a high bioaccumulative potential, thus high concentrations of Hg may accumulate in fish tissue. Mercury in Atlantic cod (Gadus morhua) is one of many things that are monitored through the Norwegian contribution to the Coordinated Environmental Monitoring Programme (CEMP) carried out by the Norwegian Institute for Water Research (NIVA) by contract from the Norwegian Environment Agency. CEMP is administered by the Oslo and Paris Commissions (OSPAR), and the results from Norway and other OSPAR countries provide a basis for a paramount evaluation of the state of the marine environment. Data on mercury and other contaminants in cod from the Inner Oslofjord (Norway) reach back to 1984. Until 2014, annual median Hg-concentrations in cod from the Inner Oslofjord displayed significant long-term (whole time series) and short-term (last 10 years) trends (when 2015 was included, the short term trend was not significant). However, the median length of the cod sampled also increased significantly over time. This is consistent with results of beach seine surveys conducted in the inner Oslofjord the emission of cod recruitment in the area has been low since the start of the 2000s. To elucidate how length would possibly impact the trend analysis, the Hg-concentrations in the cod muscle were normalized to that of 50 cm cod. No significant long- or short-term trends could be observed for the normalised Hg-concentrations. The results indicated that most of the upward trend in Hg-concentrations in cod muscle from a recreational fishery during the period from 2000 to 2017, was due to sampling bias. These findings point to the need for uncovering the effect of cod length/age on the mercury concentration trends also on other localities along the Norwegian coast. The results from this analysis is newly finalized and will be presented.

MOPC25
Contributions from biomass burning to mercury emissions at Cape Point, South Africa V.S. Somersom, CPUT / Chemistry; C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; L.G. Martin, South African Weather Service; C. Walters, CSIR / Natural Resources and the Environment

Mother (GEM) is known to be a persistent and toxic heavy metal that can bio-accumulate in the aquatic environment and lead to serious human health effects. Hg is released into the atmosphere from both natural and anthropogenic sources, wherein the atmosphere it can be present in a gaseous phase or in particulate matter. Results of work being in progress have been conducted in the Inner Oslofjord the emission of cod from various sources in southern Africa for the last decade. These studies have shown that the emissions from coal burning are reasonably well documented, with some recent inventories showing Hg results between 40 – 50 t Hg/yr in 2004 to 2006. However, only a few attempts have been made to estimate the mercury emission from biomass burning to the atmosphere in South Africa. This study presents results from controlled experiments which were conducted from February to October 2016, in which the gaseous elemental mercury (GEM) measurements in conjunction with the measurement of trace gases (CO, CO₂, CH₄, O₂), meteorological parameters and air mass trajectories were studied.

MOPC26
Building a predictive model for methylmercury photodemethylation in freshwater ecosystems S. Klapstein, Acadia University / Earth & Environmental Science; D.A. Risk, St Francis Xavier University / Earth Sciences; S.E. Ziegler, Memorial University of Newfoundland / Earth Science; N.J. O'Driscoll, Acadia University / Department of Earth and Environmental Science

Quantifying why and how some ecosystems are more sensitive to contamination following atmospheric mercury deposition is key to mercury fate modelling. Photodemethylation of MeHg is thought to be one of the main processes that convert MeHg into a less biologically toxic form of mercury [4]. While previous studies highlight the importance of photodemethylation to mercury budgets, few have examined the magnitude of MeHg production as a function of associated dissolved organic matter (DOM). DOM absorbs specific wavelengths of solar radiation and therefore MeHg that is bound to these compounds containing photoreactive functional groups may be more readily degraded than unbound MeHg. Alternatively, DOM may shade much of the water column and inhibit photodemethylation. To address this research gap we have used newly developed models to control and semi-controlled experiments that focused primarily on the quantification of the relationships between solar radiation exposures, DOM, and MeHg within six freshwater lake systems in Keijminkjuk National Park and National Historic Site in southwestern Nova Scotia. Using incident irradiation values measured from floating instrumentation the incoming UV-A could be modelled with depth in the lakes as DOM concentration changes. From these numbers we were able to apply our photodemethylation rate constants, derived from controlled experiments, to available UV-A to predict the loss of MeHg based entirely on DOM concentration (Figure 1). In the subset of Keijminkjuk National Park lakes that were studied, lakes with higher DOM lost much less MeHg through the
photoelectromechanical pathway and a strong seasonal difference due to variation in incoming solar radiation was evident. This model may be appropriate for other aquatic ecosystems by simple standardization techniques depending on water quality characteristics such as DOM photoactivity (structure), pH, and dissolved ionic species. Overall, this body of work yielded a method for predicting mercury availability to food webs depending on environmental and physicochemical factors. Climate change in temperate and boreal regions of Atlantic Canada is projected to influence food web interactions and mercury concentrations and thus lead to browning of freshwater and further inhibition to the photoelectromechanical pathway at the bioavailability stage.

**Fungicides - an overlooked compound group? Fate, effects, risk assessment and mitigation (PC)**

**TUPC01** Over the risks from fungicides for aquatic organisms  
J.P. Zubrod, University of Koblenz-Landau / Institute for Environmental Sciences; J.R. Rohr, University of South Florida / Department of Integrative Biology; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; C. Bruehl, University of Koblenz-Landau / Institute for Environmental Sciences; M. Bondschuh, Swedish University of Agricultural Sciences / Department of Agriculture Sciences and Assessment; R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences

As fungal pests are a major threat to crop production, the application of fungicides to control fungal infestations is considered indispensable to secure global food supply. The use of fungicides is forecasted to increase due to altered climatic conditions and invasive fungal species. Following their use, fungicides can enter aquatic ecosystems and, given their typically frequent application, ecotoxicologically relevant levels of fungicides can occur in surface water bodies in agricultural catchments throughout the growing season. However, in comparison to herbicides and insecticides, the fate and effects of fungicides have received less attention. To highlight research gaps, we reviewed the current knowledge on fungicide effects for aquatic organism groups (microorganisms, plants, as well as invertebrate and vertebrate animals) with a particular emphasis on the functional and ecosystem level. Related contributions reviewed fungicide exposure and mitigation measures. Within aquatic systems, aquatic fungi appear to be particularly at risk of adverse effects because fungicides are designed to control their terrestrial relatives during crop production. Indeed, structural and functional interactions in aquatic fungal communities have been reported in field and laboratory studies. As fungi positively (e.g., conditioning of detritus) and negatively (e.g., via parasitism) interact with other organisms, such effects have been shown to result in indirect fungicide effects on other taxonomic groups. In addition, other taxonomic groups can also be directly affected by fungicides because these substances act on biological processes that are highly conserved (e.g., energy production). Direct fungicide effects on aquatic non-fungal microorganisms, plants, as well as invertebrate and vertebrate animals. We will discuss these effects for several fungicide/mode of action that were comprehensively tested in laboratory and semi-field studies. Subsequently, we discuss current risk assessment procedures for fungicides in the light of identified knowledge gaps and provide recommendations for amendments that can be inferred from our findings.

**TUPC02** Relative tolerance of aquatic organisms to fungicides  
A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; M. Daum, New University of Lyon

Fungicide compounds are routinely used in intensive agriculture production to treat a wide range of plant pests and microbial pathogens. These compounds may reach aquatic ecosystems by spray-drift, leaching and runoff, posing a potential threat to aquatic organisms. In this study we evaluated the sensitivity and relative tolerance of target aquatic organisms with a particular emphasis on the functional and ecosystem level. Related contributions reviewed fungicide exposure and mitigation measures. Within aquatic systems, aquatic fungi appear to be particularly at risk of adverse effects because fungicides are designed to control their terrestrial relatives during crop production. Indeed, structural and functional interactions in aquatic fungal communities have been reported in field and laboratory studies. As fungi positively (e.g., conditioning of detritus) and negatively (e.g., via parasitism) interact with other organisms, such effects have been shown to result in indirect fungicide effects on other taxonomic groups. In addition, other taxonomic groups can also be directly affected by fungicides because these substances act on biological processes that are highly conserved (e.g., energy production). Direct fungicide effects on aquatic non-fungal microorganisms, plants, as well as invertebrate and vertebrate animals. We will discuss these effects for several fungicide/mode of action that were comprehensively tested in laboratory and semi-field studies. Subsequently, we discuss current risk assessment procedures for fungicides in the light of identified knowledge gaps and provide recommendations for amendments that can be inferred from our findings.
TUPC03 Fungicide effects propagate through the detrital food chain in streams

J. Rasmussen, Aarhus University / bioscience; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; M. Skov Pristed, Aarhus University / Department of Bioscience

Fungicide use in Europe equals that of herbicides, but the amount of studies addressing ecological effects of fungicides is disproportionately low. Recent studies suggest that particularly freshwater fungi may be susceptible to fungicide exposure leading to changed fungal community structure and reduced fungal biomass. These effects may negatively influence the food quality for higher level consumers, e.g. invertebrate shredders. Fungicides occur rather continuously in low concentrations in agricultural streams especially during cropping seasons suggesting that long-term chronic exposure scenarios should be covered in ecotoxicological research. We conducted a 5 month stream channel experiment using two environmentally realistic concentration levels of a quaternary fungicide mixture to investigate long-term effects of chronic fungicide exposure of a leaf decomposer assemblage containing fungal communities and two species of cadelline shredders: Chaetopteryx villosa and Anabola nervosa. Food availability was additionally manipulated ranging from excessive to limited food availability (three treatment levels). Fungal biomass significantly decreased with increasing fungicide concentrations, and the fungal community structure was significantly different in the highest fungicide treatment compared to the lowest fungicide treatment and the untreated control. Fungal species richness was consistently and significantly lower in the treatments containing highest fungicide concentrations and always highest in the untreated control. Emergence success of C. villosa significantly decreased with increasing fungicide concentration from >90% in the untreated controls to < 20 % in the highest fungicide treatment at maximum food availability. Minimum food availability further increased fungicide effects. Significant effects occurred at concentrations a factor of 2 to 200 below the EC50(micro) concentrations for chronic algae ecotoxicity tests. Our study highlights that environmentally realistic fungicide exposure may propagate through the detrital food chain in streams at concentrations that are well below the Regulatory Acceptable Concentrations. Hence, supplement ecotoxicity tests (e.g. based on aquatic fungi) are probably necessary for sufficiently safeguarding stream ecosystems in the risk assessment of fungicides.

TUPC04 Mitigation of fungicide exposure of stream ecosystems within agricultural catchments

M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences

Fungicides are a vital part of the agricultural pest management. As a consequence, fungicides – such as all pesticides – reach surface water bodies mainly through spray drift and runoff. To mitigate fungicide exposure, a range of mitigation measures have been put forward. A densely vegetated and wide buffer strip surrounding surface water bodies, for instance, can be efficient to reduce the spray drift of fungicides during application. Also during runoff, buffer strips have been suggested as a potential measure mitigating fungicide exposure by retaining runoff water and providing sites for adsorption as well as degradation. Under field conditions, however, vegetation density and erosion rills underneath the buffer strips' mitigation potential. Once released into aquatic ecosystems, (constructed) wetland and vegetated systems are considered an effective tool for mitigating a downstream transport of pesticides. The efficiency of such systems depends on both the physico-chemical properties of the pesticide of interest as well as system inherent properties. The pesticides affinity to organic carbon (Koc) is one physico-chemical property driving their retention, with more hydrophobic substances being more efficiently retained. Although fungicides are usually rather hydrophilic, their peak concentrations were also shown to be reduced by such vegetated systems. The systems' efficiency in doing so, is modulated by size related properties as well as plant density. Both parameters are increasing the retention time of fungicides and thereby the probability for adsorption and degradation processes to take place. Mitigating the fungicide exposure via spray drift and runoff may thus efficiently be addressed by a combination of measures. Those measures may include the proper management of vegetated buffer strips. This mitigation measure may be supported by the implementation of vegetated systems (such as constructed wetlands) in situations where catchment characteristics suggest a high risk that cannot be controlled by buffer strips or where such buffer strips cannot be realised.

TUPC05 Towards a better exposure assessment of antifungal azoles

N. Creutz, Eawag - Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; M. Casado, Eawag - Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; B.J. Ferrari, Centre Ecotax EAWAGEPFL; S. Fischer, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; N. Munz, Eawag / Environmental Chemistry; H. Singer, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; S. Spycher, B. Spycher, Eawag Swiss Federal Institute of Aquatic Science and Technology; C. Stamm, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; A. Tili, Eawag / Department of Environmental Toxicology; I. Wittmer, Plattform Wasserqualität VSA; J. Hollander, Eawag / Environmental Chemistry

Antifungal azoles are a class of contaminants of emerging concern since increasing evidences highlight their potential effect on aquatic organisms at different trophic levels, raising the need to evaluate the associated environmental risk. Although a few of these compounds are routinely investigated, an accurate exposure assessment of most of them is still lacking to evaluate this risk. To address this issue, we first defined a list of 60 antifungal azoles including pesticides and pharmaceuticals based on the use/consumption of these compounds in Switzerland and Germany. We then performed a retrospective suspect screening on a set of data acquired with liquid chromatography-high-resolution mass spectrometry (LC-HRMS) from a large panel of environmental samples to complete previously targeted analyses on azoles. Since antifungal azoles are used both as pharmaceuticals and pesticides these samples included wastewater treatment plant effluents (WWTPs), river surface waters, biota from rivers (fish, gammarids, biofilms), river and lake sediments, soils and groundwater from various sites allowing to encompass different sources of anthropogenic pressures. The results revealed that antifungal azoles are widely distributed in aquatic ecosystems (e.g. from...
Ecological testing and risk assessment considerations for microbial active substances
E.A. McVey, J. Wassenberg, Ctgb
For some types of biological pesticide active substances, the same testing schemes
and methodologies as used for chemical active substances suffice. However, for others
(for example, microbial active substances), the unique properties of the
substances and resulting risk assessment questions result in the need for a
different perspective on the appropriate testing guidelines and programs, as well as different
considerations for the risk assessment assumptions and methodologies. Comparing
and contrasting the risk assessment theories and available testing methods, it is
clear that while some areas of the risk assessment can be translated between
chemical and biological actives, the majority require unique and thoughtful
innovations to address the risk assessment objectives. This is particularly well
illustrated in the ecological risk assessment schemes for microbials, where testing
should be performed under conditions such that both the (various) test organisms
and also the microbial active are in an optimal environment. Unique and unknown
mechanisms of action and toxicity may also present, and be dependent upon the
exposure conditions. Similarly to chemical actives, exposure estimations with
microbials are also highly dependent upon environmental conditions, however, microbial active substances may remain
favorable for length of time due to the presence of plasmid resistance genes.
Knowledge from both the biological and chemical testing and risk assessment
areas should be comprehensively surveyed and utilities to advise more appropriate
and adequate testing for microbial active substances.
TUPC09
Human and environmental Risk assessment for microorganisms - to what extent?
A. Cornelles, J. Stüt, GAB Consulting GmbH; A. Jakubowska, GAB Consulting
Spain S.L.U.; S. Seehase, R. Hauschild, GAB Consulting GmbH
Biopesticides are an excellent alternative to chemical pesticides, and there is
continuously increasing interest with both industry and consumers. The Sustainable
Use Directive (2009/128/EC) strengthens the use of integrated control of pests and diseases where non-chemical measures are
preferred. Plant protection products with a microorganism as active substance could be a solution. Microorganisms have to be approved in Europe in order to be used as
active ingredients in biopesticide products. Data requirements for pesticides based on
microorganisms are available as separate part of the regulation EC 283/2013 and EC 284/2013. The Regulation provides the scope of the data required about the exposure levels than most chemical actives. Regardless of these obstacles, some
logical and objective recommendations can be made, both regarding testing and risk assessment for microbial active substances. Considerations of microbial active substances in groups based on pesticide mechanism of action and/or organism
group may allow development of some generic testing recommendations. Knowledge from both the biological and chemical testing and risk assessment
areas should be comprehensively surveyed and utilities to advise more appropriate
and adequate testing for microbial active substances.
TUPC10
Ecotoxicological testing to support the assessment of Microbials
Biopesticides are an excellent alternative to chemical pesticides, and there is
an increasing demand in testing and evaluation of these products. This poster focuses on
microbial pesticides based on bacteria, fungi, viruses or protozoas as their
active substances. Possible adverse effects to non-target organisms (NTO) are
rather limited due to the narrow and specific host range of these microbial pest
control agents. However, a complete risk assessment demands testing of NTOs,
when exposure and risk can be fully neglected. The assessment of microbial
biocontrol agents (mBCA) and microbial biological control products (mBCP)
is relatively new and approved testing methods are not yet available in the
same extent as they are for chemical pesticides. Not only the toxicity, but also the
potential pathogenicity/infectivity needs to be addressed. Currently, the data
requirements for mBCAs and mBCPs are issue of Part B of the European
regulations 283/2013 (mBCA) and 284/2013 (mBCP). Numerous data
requirements listed in these annexes were transformed directly from requirements
for chemical pesticides and often cannot be adapted to the biological properties
of microbials. In order to address the data requirements in a feasible manner, the biological
properties of the microorganisms have to be taken into account, instead of
strictly applying to current test guidelines. It is important to note, that testing is
strongly influenced by physico-chemical properties of mBCAs. Microorganisms, i. a. with frequently used co-formulants, are not soluble which results in alteration of the test conditions (i.e. turbidity, O₂demand, spray layers). Furthermore, organic
components of the formulated product (i.e. yeast, starch) may lead to increased
fungal growth in soil or test media. Additionally, the need to test at high
concentration levels, leading to negative effects of partners (i.e. spores or co-
formulants like kaolin) on the test organisms which are not related to the active
substance and are difficult to interpret. Differences between OECD and OCSP
(formerly OPPTS) guidelines, and requirements of the analytical verification
in the test medium are addressed as part of the development of alternative
ecotoxicological testing approaches. The findings of our ecotoxicological expertise
presented in this poster can be considered as basis for further discussion in
proposing different test designs addressing mBCA and mBCP requirements.
TUPC11
Microbiological Quantiﬁcation Methods for MPCA’s – Applicability to a
Range of Microorganisms and Different Substances
M. Zettmann, F. Kümmich, M. Zettmann, F. Kümmich, M. Zettmann, F. Kümmich
In the last decade the number of biopesticide registrations in the EU and US have
steadily increased. In the EU biopesticides are regulated as plant protection products
under regulation 1107/2009. Biopesticides cover a wide spectrum of substances
including microbial pest control agents (MPCA) defined as products containing
microorganisms (e.g. bacteria, fungi, protozoas, viruses). As for chemical plant
protection products, regulatory authorities require an analytical verification of the
doses applied in eco-toxicological tests also for MPCAs. Guidance can be derived from
SANCO/3030/99 rev.4 and OPPTS 885.1400 (1996), but verification
procedures need to be adapted on a case by case basis, as each microorganism
possesses its own chemical properties and different growth conditions. Just as
chemical methods, microbiological tools need to be developed and validated for
specific microorganisms in order to be accepted in the registration process of
biopesticides. Experimental data will be presented with focus on the applicability of microbial
quantitation methods considering different microorganisms and substances.

When ecotoxicology meets trophic ecology (PC)
TUPC17
Modelling bioaccumulation of persistent organic pollutants in Arctic food
chains
R. Hoffert, Radboud University Nijmegen / Department of Environmental Science
A.M. Ragas, Radboud University / Department of Environmental Science
J.A. Hendriks, Radboud University Nijmegen / Department of Environmental Science
Persistent organic pollutants (POPs) are a group of chemicals with similar
physical-chemical characteristics that are resistant to environmental degradation
and biodegradation. Not only do these POPs bioaccumulate in the food chain, they
are also known to cause adverse effects in fish, wildlife and humans. Although
being banned in the previous century, many POPs are still present in high
concentrations in Arctic areas, due to a combination of northward marine currents and
their semi-volatile nature, high thermal stability and slow degradation turnover
rates. As food webs in the Arctic are relatively simple, POP contamination may
potentially have a great impact on animals at higher trophic levels, such as the polar bear (Ursus
maritimus), hence the growing interest in studying bioaccumulation in the Arctic.
Despite the large interest in bioaccumulation in Arctic food chains, the OMEGA
model, as well as similar bioaccumulation models, are predominately validated on
temperate food chains or relatively straightforward Arctic food webs. In the
present study, we aim to model bioaccumulation of multiple persistent
compounds in the Arctic encompassing multiple species, using the OMEGA (Optimal
Modelling for Ecotoxicological Application) bioaccumulation model. In this study,
we aim to validate the model on Arctic areas by using a binning approach to include
multiple species, in which species of a similar trophic level were binned.
TUPC18
Distribution and Trophic Magnification of Dechloranes, HBCDs, PCNs, and
Other Legacy POPs in the Maritime Antarctic Ecosystem
J. Kim, Korea Polar Research Institute / Division of polar environment; Y. Choi, POSTECH Pohang University of Science and Technology; M. Barghi, POSTECH; J. Kim, J. Jung, Korea Polar Research Institute; Y. Chang, POSTECH Pohang University of Science and Technology
This study investigated distribution and trophic magnification of emerging persistent
organic pollutants (POPs), including PCNs, HBCDs, Dechloranes, polychlorinated
biphenyls (PCBs) and organochlorine pesticides (OCPs) in the
maritime ecosystem in King George Island, Antarctica. The samples were collected in
the Baton Peninsula in King George Island, Antarctica. From December 2013 to
January 2014, and included Antarctic cod, icefish, limpet, amphipods, leopard seal,
Gentoopenguin, Chinstrap penguin, kelp gull, and south polar skua, PCNs,
HBCDs, Dechloranes, DDTs, HCHs, Pentachlorobenzene (PCBz),
Hexachlorobenzene (HCBz), Chlorodanes, PCBs were detected in all samples, and
the levels were the detection rates for the legacy POPs were more than 90 %, but
those of some new POP compounds were only 50%. The detected POP levels in this
study were much lower than the levels in the previous study in low and mid latitude region, and even those in the Arctic. The trophic magnification factor (TMF) of each POP compound were calculated based on the ratio of stable isotope nitrogen and the log-transformed POP concentrations. Some of the compounds, OCs, HBCDs and highly chlorinated PCBs and PCNs, showed significantly positive correlations, suggesting biomagnification of the chemicals. DPs, however, showed insignificant TMFs. After the TMF analysis for aquatic and terrestrial food web models, TMF values showed different trends compared to the TMFs in whole sample model. The inclusion of migrant animal, such as south pola skua and kelp gull, also arose an uncertainty to evaluate TMFs. The result of this study presented widespread contamination of the Arctic Environment by the New and Legacy POPs. The levels of most POPs were magnified through trophic levels, while Dechloranes, emerging contaminants, appeared not to enough TMF values. The insufficient detection rate of Dechloranes, complexity of the food web structure, and the overestimation due to migrant animals arose the uncertainties in TMFs, and therefore need to be taken into consideration to interpret the TMF results in this study.

TUPC19
Bioconcentration as the predominant mechanism for fish PCB contamination in alpine lakes.

T. Masset, Universite Savoie Mont Blanc; M. Perga, University of Lausanne / Faculty of Geosciences and Environment; N. Cottin, Universite Savoie Mont Blanc; S. Cacheria, CISALB; C. Piot, E. Naffrechoux, Universite Savoie Mont Blanc.

Bioconcentration and biomagnification relative contribution to the PCB burden in freshwater fish in alpine lakes ecosystems remain a debated issue. The aim of this study was to identify the relative role of those different processes for two fish species Coregonus lavaretus (European whitefish) and Salvelinus alpinus (arctic char) in one of the heaviest PCB contaminated alpine ecosystem: lake Bourget (France). The 7 indicator-PCB concentration and lipid content of fish filet were measured in European whitefish (n=89) and arctic char (n=55) from 2013 to 2016. Potential explanatory variables for differences in PCB contamination levels in fish were chosen to identify the impact of living and feeding habitat (using d13C) and the influence of trophic parameters using d15N.

TUPC20
The role of diet and age: organohalogen accumulation in an avian top predator

M.E. Loseth, The Norwegian University of Science and Technology / Biology; N. Briels, Norwegian University of Science and Technology / Biology; I. Eulaers, University of Antwerp / Biology; T. Nygård, T.V. Johnsen, J.O. Bustnes, Norwegian Institute for Nature Research NINA; D. Herzke, NILU - Norwegian Institute for Air Research / FRAM Centre Tromso; G. Pompa, G. Malavannan, University of Antwerp / Toxicological Center; A. Covaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; B.M. Jenssen, Norwegian University of Science and Technology / Biology; V. Jaspers, Norwegian University of Science & Technology / Biology; M. Trznadel, University of Exeter / Biosciences; J. Fitzgerald, University of Exeter / Biosciences College of Life and Environmental Sciences; R. Boreham, M. Griffiths, University of Exeter / Biosciences College of Life and Environmental Sciences; G. Cottin, University of Exeter / Biosciences College of Life and Environmental Sciences; N. Cottin, University of Exeter / Medical School; E.M. Santos, University of Exeter / Biosciences College of Life and Environmental Sciences.

This study aimed to investigate how the effect of PCB bioaccumulation and PCB biomagnification would differ between the two life stages, especially given the large difference in age and increase in body mass when monitoring OHCs in nestlings. The aim of the present study was to investigate how differences between years, locations and the diet of nestlings can be exposed to an early age. Their diet consists mainly of fish and seabirds; thus, a long food chain Occupying a high trophic level, the white skua and kelp gull, also arose an uncertainty to evaluate TMFs. The result of this study presented widespread contamination of the Arctic Environment by the New and Legacy POPs. The levels of most POPs were magnified through trophic levels, while Dechloranes, emerging contaminants, appeared not to enough TMF values. The insufficient detection rate of Dechloranes, complexity of the food web structure, and the overestimation due to migrant animals arose the uncertainties in TMFs, and therefore need to be taken into consideration to interpret the TMF results in this study.

TUPC21
Fate of PAH, phthalates and their metabolites in an urban river food web

M. Chevreuil, EPHE / UMR METIS 7619; R. Santos, Hepia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; P. Labadie, UMR CNRS EPOC Universite Bordeaux / UMR 5805 EPOC.

Trophic magnification factors have been extensively assessed for persistent organic pollutants, but remain poorly studied for metabolizable pollutants and their metabolites. Polycyclic aromatic hydrocarbons (PAHs) and phthalate plasticizers are continuously released in urban rivers and are rapidly metabolised and excreted by freshwater organisms, thus limiting their bioaccumulative potential. Abiotic and biotic samples, from primary producers to piscivorous fish, were collected in an urban river and analysed for PAHs, phthalates and their metabolites. Stable isotopes of nitrogen were used to determine trophic levels and to calculate trophic magnification factors (TMF) of each compound and its associated metabolite. Our results highlight a trophic dilution (TMF = 1) of all PAHs and phthalates, meaning that predators were less contaminated than their preys. When taking into account the associated metabolites, total body burden of PAHs still declined with increasing trophic levels, confirming the rapid transformation and excretion of these compounds within organisms and a very limited trophic transfer. In contrast, the level of phthalate compound and its associated metabolite(s) increased from prey to predators, suggesting a lower clearance rate of phthalates and a slight biomagnification potential across freshwater food webs. At the light of these results, it appears essential to consider phthalate metabolites, instead of phthalate diesters only, in environmental risk assessment.

Epigenetic and evolutionary toxicology: from mechanisms to risk assessment (PC)

H. Littler, University of Exeter / Biosciences College of Life and Environmental Sciences; L.V. Laing, University of Exeter / Biological Sciences; R. Boreham, M. Griffiths, University of Exeter / Biosciences College of Life and Environmental Sciences; M. Trznadel, University of Exeter / Biosciences; J. Fitzgerald, University of Exeter / Biosciences College of Life and Environmental Sciences; G.C. Paull, University of Exeter; R. van Aarle, Centre for Environment Fisheries and Aquaculture Science / Biosciences College of Life and Environmental Sciences; J. Mill, University of Exeter / Exeter Medical School; E.M. Santos, University of Exeter / Biosciences College of Life and Environmental Sciences.

Does pre-exposure to bisphenol A affect the susceptibility of breeding zebrafish upon re-exposure?

A. Vosper, F. Alliot, EPHE / UMR Metis; H. Budzinski, University of Bordeaux; WTE is a marine top predator; however due to the topography of the island Smøla WTEs may feed on a mixed terrestrial and marine diet. According to our preliminary analyses, WTEs in Steigen are feeding on a slightly higher trophic level than WTEs in Smøla WTEs, and may consequently accumulate more of the investigated OHCs. However, in our analyses the SI values were only important in explaining variation in POPs but not for PAH levels. We also observed that age at sampling is an important factor, as legacy POPs are decreasing while PAFs are increasing with age. However, there are differences between years at each location with higher OHC concentrations for Steigen in 2015 and Smøla in 2016, not explained by age or diet. Our analyses also demonstrate large variations within nestlings, suggesting that siblings may not always share prey. We hereby emphasize the importance of ecological and biological variables when investigating OHCs in an avian top predator.

[499 SETAC Europe 28th Annual Meeting Abstract Book]
naive adults which received a single exposure to BPA (C-100). This suggests that pre-exposure of adult fish leads to a protective effect on their offspring. We hypothesise that these effects may be due to physiological changes or epigenetic memory between the first and second exposure period, and will now analyse the promoter DNA methylation of amh to investigate this hypothesis.

WPEC02
Zebrafish as a model to assess transgenerational effects of environmental stress via epigenetic inheritance

J. Kamstra, NMBU / BaSam

Although toxicological effects of anthropogenic stressors present in the environment are studied extensively, few studies assess the epigenetic effects of such stressors on the next generation. We assess these effects over multiple generations. It is hypothesised that some stressors are able to change the epigenetic state in germ cells causing effects on histones modifications, DNA methylation and miRNA expression, potentially inherited by subsequent generations. Here, the aim was to elucidate the role of epigenetics in transgenerational inheritance of effects of different stressors by measuring all epigenetic layers using the zebrafish model. Transgenerational studies were performed with three different stressors: a DNA methylation inhibitor, 5 azacytidine (5AC); a phthalate metabolite, mono2-ethylhexylphalathate (MEHP) and irradiation. We employed state-of-the-art techniques to assess effects in multiple generations of zebrafish embryos and larvae at all epigenetic layers, but most extensively on DNA methylation. Following early life exposures to 5AC and MEHP, many changes of DNA methylation were found in the offspring, and these changes could be linked to gene pathways that are associated to those compounds, such as embryonic development and obesity. Subsequent analysis in two following generations lead to the conclusion that some regions were persistently changed. Concerning ionizing radiation, in F1 embryonic offspring from irradiated parents, many changes of DNA methylation were observed. These changes could be linked to effects that were found in the postnatal DNA damage. Follow up analysis in the second and the third generation, revealed persistent effects of DNA methylation in a number of regions. Additionally, miRNA analysis in the offspring revealed a number of differentially expressed miRNA linked to similar pathways as with the DNA methylation dataset. Finally, changes in histone modifications were found at specific loci, but these changes were not observed in the second generation. Our results reveal considerable effects on DNA methylation following exposures during early life in zebrafish to MEHP, 5AC and ionizing radiation, as well as a role for miRNAs and histone post translational modifications for the latter. By linking the DNA methylation data to genes, results indicate a functional role for DNA methylation in zebrafish. Persistent effects in F2 and F3 implies that DNA methylation changes can be inherited by multiple generations.

WPEC03
Can changes in DNA methylation be linked to exposure of plants to radiation over multiple generations?

N. Horeman, Belgian Nuclear Research Centre (SCK-CEN) / Biosphere Impact Studies; E. Van Hove, SCK-CEN; M. Vanheule, SCK-CEN / Biosphere Impact Studies; S. Gaschak, Chornobyl Centre; K. Namba, Institute of Environmental Radioactivity; R. Nauts, SCK-CEN

In this study the impact on plants of long-term (transgenerational) exposure to radiation coming from nuclear accidents like Fukushima and Chernobyl is investigated and compared with lab experiments in either a chronic, acute, multi-, or single exposure radiation set up. Results show that changes in DNA methylation could be the basis of transgenerational changes found in field or lab conditions. A field campaign was performed in both Chernobyl (CEZ) and Fukushima affected areas (FEZ) in the course of May 2016. Annual Brassicaeae species, Arabidopsis thaliana and Capsella bursa pastoris in CEZ and FEZ, respectively, were sampled alongside a gradient of enhanced radiation ranging from 0.5 to 50 μGy.h⁻¹. Seeds from Arabidopsis thaliana were harvested in the CEZ and grown for one clean generation under lab conditions to score for multigenerational effects. In addition further lab experiments were performed on wild type plants of Arabidopsis thaliana grown under chronic exposure conditions (at 1 mGy/h) or more acutely (20 to 400 μGy/h) for 14 days in one, two or three generations. Plants were stressed for the evaluation of photosynthetic and oxidative stress markers as well as germination rate and root growth. In general higher differences are found in plants exposed in a multigenerational setup than in a transgenerational one. The field plants did not show any abnormalities that could be correlated with the exposure gradient although some delay in flowering was observed in plants from medium and high radiation levels. The level of total DNA methylation could not be linked to the radiation gradient present in the field but rather differences in developmental stage of the collected plants. In lab-exposed plants however global DNA methylation showed a significant increase which was both dose and generation dependent. Significant changes in transcription of methylation regulating genes were also measured in the different generations. Highest differences were present in the S1 generation but seemed to be reduced in the S2 generation. Overall the data hint towards a role of methylation in the response to radiation but its use as marker of exposure or in risk assessment needs further experimental evidence and discussion. This work was supported by European project COMET (7th PCRD EURATOM Contract Number: Fission-2012-3.4.1-604794) (www.comet-radioecology.org)generation.

WPEC04
Evolutionary toxicology: tools to understand impacts of past, present and future environmental contamination

S. F. Crawford, RWTH Aachen University / Institute for Environmental Research, Dept. of Environmental Analysis; D. D. Oudshoorn, RWTH Aachen University / Department of Ecosystem Analysis; M. Hinderer, Technische Universität Darmstadt / Institute for Applied Geoscience; A. Schwabl, Technische Universität Braunschweig / Institute for Geosystems and Biosindication; H. Hollett, RWTH Aachen University / Institute for Environmental Research

This research will utilize environmental reconstruction methods along with paleoecological, paleontological, and palaeogenomic techniques to understand historical, current and potentially future trends in environmental contamination and associated impacts on lake systems. Long-term exposure to environmental contaminants can cause genetic adaptations in exposed populations of aquatic organisms. The new research fields of evolutionary toxicology and resurrection ecology offer powerful tools for the investigation of changes in sensitivities and adaptive trajectories of populations exposed to contaminants and environmental stressors over decades to centuries. Dormant resting eggs produced by Daphnia species (Crustacea: Cladocera) as a result of unfavourable environmental conditions are archived in sediments and can be dated and hatched to produce clonal lineages (i.e., same genotypes) of historical populations. This talk will present an overview of the evolutionary tools available and their current and potential use in toxicological investigations. Additionally, we will present our preliminary research, which examines how genotypes of clonal lineages of Daphnia species from single populations, separated through generations of evolution, differ in their response to exposure of stressors. Results will provide insight into the sensitivity and fitness of organisms in response to environmental contaminant exposures and the micro-evolutionary adaptations of genes that evolve in response to contaminant exposure. Persistent effects of transgenerational change in aquatic organisms can also result from other environmental stressors, such as temperature. Since increased temperatures are expected to occur in the future as a result of predicted climate scenarios, it is important to examine the fitness of historical and recent clones of Daphnia to temperature changes in combination with exposure to contaminants. Toxicological assessments and genomic data obtained from these archives of natural populations will provide unprecedented opportunities to gain insight into long-term and potentially future evolutionary responses of natural populations to environmental changes resulting from environmental stressors, including contamination and climate change.

WPEC05
Chemical and physical stressors shape the population genetic structure of aquatic invertebrate populations

P. Inostroza, University of Gothenburg / Effect Directed Analysis; I. Véra-Escalona, Dalhousie University / Biology; A. Wicht, Eberhard Karls Universität Tübingen / Chemistry; M. Krauss, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; H. Norf, Helmholtz Centre for Environmental Research GmbH - UFZ / River Ecology Aquatic Ecosystems Analysis and Management

Organisms are rarely exposed to only one single stressor in the environment, but rather to multiple human-derived threats working simultaneously. Environmental pollution can modify population genetic structure via ecological bottlenecking, which may result in decreased genetic diversity or increased effective population size, or increasing mutation rate. Organic micropollutants such as pesticides, biocides, pharmaceuticals, personal-care products, or industrial chemicals are ubiquitous in the aquatic environment and their effects are considered a relatively new and emerging anthropogenic pressure over evolutionary processes, especially potential effects of pollutants on genetic population structure may be more disruptive regarding ecosystem functioning than individual-level effects. Despite the bunch of investigations on genetic variation in wildlife, our understanding about the individual stressor effects on genetic variation is still limited. Recently, there has been an increased interest to integrate environmental chemistry and evolutionary toxicology approaches into the assessment of direct and indirect effects of anthropogenic pressures on genetic variation. To address these challenges the genetic structure of a shredder invertebrate, Gammarus pulex, was examined using evolutionary toxicology and body burden of organic micropollutant approaches. Exposure to chemical pollution alone and in combination with the presence of weirs resulted in a depression of allelic richness in native G. pulex populations. Our results suggest that the input of a mutagenic effluent from a WWTP resulted in a strong increase in private alleles over the affected populations. In addition, the results suggest that the input of a mutagenic effluent from a WWTP resulted in a strong increase in private alleles over the affected populations.
What's your take on communication? Don't Panic! Reports on how to accurately communicating science and risk (PC)

WPC07
Dangerous misconceptions - Consumers need help!
U. Klaschka, University of Applied Sciences

Recent surveys revealed that average consumers and even more illiterate people are struggling with risk communication instruments for harmful substances in commodities. The majority of consumers do not understand risk communication instruments as intended by legislators or do not use them at all. In contrast, the present survey focused on 'best-case' consumers who are interested in the topic, have a good education or a good self-reported knowledge in chemistry. These 'best-case' consumers use preferentially hazard pictograms in accordance with the Regulation on Classification, Labelling and Packaging (86%), reports in the media (80%) and information printed on the products (77%) to learn about harmful substances in consumer products. Surprisingly, smartphone applications (<10%) and information by authorities (14%) were not indicated as frequently used information sources. Most respondents considered information published by consumer and environmental organizations (75%) and the hazard pictograms (74%) as trustworthy. Interestingly, the respondents considered legislators (94%), consumers (75%), manufacturers (71%) and environmental and consumer organizations (61%) as responsible for risk reduction. It is alarming that many of these ‘best-case’ participants assumed that food (up to 62%), products with an environmental label (36%), natural personal care products (36%), homeopathic products (30%), natural pharmaceuticals (26%) and products without hazard pictograms (11%) would not contain substances harmful for health or the environment. Nearly one out of ten respondents did not know that consumer products can contain harmful substances. These results show that motivation and knowledge in chemistry help, but are not sufficient. Consumers need support to understand the risk communication instruments they need support to understand which products might contain harmful substances, they need support to determine the impact of harmful substances in commodities and they need support for suitable risk reduction behavior.

WPC08
The European Union Observatory for Nanomaterials (EUON): A new platform for communicating information on the safety of nanomaterials

The REACH and CLP regulations are two key regulations addressing the manufacture and use of chemicals and the impact of these chemicals on human health and the environment. Although these regulations do not contain explicit requirements for nanomaterials, the regulations nevertheless address all chemical substances, including nanomaterials. In addition, over the past years, significant refinement on markets and safety aspects of nanomaterials in the EU market. In spite of this, there is a perception that there is insufficient information available in the public regarding the safety of nanomaterials. As a result, the European Commission entrusted ECHA with the creation, management, and maintenance of the European Union Observatory for Nanomaterials (EUON) [1] via a delegation agreement in December 2016[2]. The aim of the Observatory is “to give objective and reliable information to all interested parties of nanomaterials in the EU market”. The presentatoin will provide an overview of the activities of the EUON, including the background, the current content of the Observatory, and planned future developments.

WPC09
Roadmap for the unknown
M. Luitwiler, M. H. Wegelmann, Bioclear earth

The main environmental themes have been addressed in the last decades. Think about acidification, nutrients and bulk industrial chemicals for which environmental guideline values have been derived within legal frameworks. Changes are ongoing in the scale level at which environmental problems are regarded as well as the scale level of industrial production. In the past large volumes of bulk chemicals were produced, now and in the future lower volumes of more specialised compounds are and will be produced. That means that more and more compounds will enter the environment in low volumes. also time-market of new developments and technologies decrease which leaves less time for a thorough risk assessment. last but not least, techniques for measuring compounds are improving. More and more compounds can be measured in increasingly low concentration while the risks of these compounds in low concentrations are not known or just being studied. For the Province of Groningen en the Water Company Groningen through the reasons to develop a policy for emerging contaminants in the environment with the main question: What to do when emerging contaminants are found in soil or water. Bioclear earth has developed a roadmap for policy and/or actions by the province, municipalities, water company and water boards for emerging contaminants in the soil-water system. Our framework was: compounds and organisms that enter the environment or can be spread by human actions and that consequently have a negative effect on humans, nature or agriculture and for which no guideline values have been derived within the Soil Law, Water Law (Water framework directive) and Drinking water decree. The first step in the roadmap is to determine if a compound or organism in the environment can cause an actual or large risk. If no risks are present, no further investigation is needed. In all other cases, the roadmap needs to be followed. In the presentation we will develop the process that has to be followed to come to this roadmap as well as the background information. In the roadmap we describe the role of different stakeholders, including communication, enforcement, measurements to further prevent contamination or spread. In the presentation these roles will be further highlighted. Additionally we will organise a workshop regarding to discharge in January for province, municipalities, water boards, water company and RWS. The results of this workshop will also be highlighted.

WPC10
EVOKE:D: enhancing the value of climate data - translating risk and uncertainty utilizing a Living Labs approach
A. M. Deeg, Norwegian Geotechnical Institute / Environmental Technology; B. Kalsnes, Norwegian Geotechnical Institute / Natural Hazards; L. Van Well, M. Zetterlund, Swedish Geotechnical Institute; G. Ellen, R. van der Bruggue, DELTARES; J. Koerth, B. Vollstedt, Christian Albrechts University of Kiel

The impacts of climate change are broad and although much focus has been on disaster risk reduction and coastal management, climate change will also have consequences for environmental management where the transport of contaminants, organism acclimation and vulnerable communities will be important to consider for future human and ecological risk assessments. In this context it is useful for environmental scientists to be familiar with the concept of climate services which are defined as the transformation of climate-related data into products, assessments, best practices) in relation to climate that may be of use for the society at large. Since the climate service sector is relatively new, there is a need to engage knowledge providers, users, and translators to identify improvements to climate services through co-design, co-development and co-evolution. The EVOKE project aims to address this challenge by re-framing the risk and uncertainty associated with climate data into knowledge products more understandable and useful for end-users concerned with risk mitigation and adaptation. The project team will engage end-users in a Living Labs approach to ensure a user-contribution innovation methodology at established case study sites in Norway, Sweden, Germany and the Netherlands. The Living Lab methodology has emerged in recent years as a form of experimental and potentially inclusive mode of urban planning. Although the scope and character can vary depending on the issue at hand, the institutional level and the degree of the problem, the general idea is to involve a range of committed stakeholders in a real-life “laboratory” setting to test and develop alternative solutions for complex challenges, such as climate adaptation. The first activity for the Living Labs at each case study site will be a co-design process to encourage stakeholders to share their perceptions of risk and uncertainty. Since there are many different definitions and interpretations of risk, understanding these perceptions of risk is a prerequisite for communicating risk. Thus, EVOKE supports the development of the field of climate services to improve our capacity to manage climate-related risks.

WPC11
Communicating monetary values of environmental impacts - case studies related to ISO DIS 14044
B. Steen, Chalmers University of Technology; K. Hallberg, AkzoNobel; P. Hanarp, Volvo Group; J. Lindberg, IVL Swedish Environmental Research Institute; E. Rise, Essity; M. Romare, IVL Swedish Environmental Research Institute; T.
Grant of AXA Research Fund (Paris, France) and the Research Focus of Earth or spatial initiatives and projects, produce educational material accessible without time towards free access, documents with open license and media useful for teaching, (phytoextraction of thallium from soils using mustard plants). All the material we will show how a complex topic, can be easily i

Technology products (optics, electronics, medicine). However, many of these elements are toxic curiosities but that now have an important place as raw materials in high and 'green energy' related technologies. Platinum, indium, thallium are good

N. Ospina

WEPC13 Let's go visual, a picture is worth a thousand words: How to explain Emerging Contaminants using animations N. Ospina-Alvarez, S. Schneider, University of Potsdam / Institute of Earth and Environmental Sciences

The development of new technologies has enhanced the use of several elements in information and communication technologies, semiconductors, electronic displays and 'green energy' related technologies. Platinum, indium, thallium are good examples of those kind of elements, that during long time were laboratory curiosities but that now have an important place as raw materials in high-tc products (optics, electronics, medicine). However, many of these elements are toxic (e.g. thallium, lead), which is a challenge for the chemical industry to find ways to use them in a way that is valued. The object may differ due to more or less use of fossil fuel is rather insensitive to how the valuation was made with respect to the ranking of alternatives. In cases where there is a trade-off between use of fossil resources and scarce metals, the choice is very sensitive to the temporal system boundary of the impacts and affected population. A database format is proposed for documenting monetary values and related metadata.

WEPC12 Full STEAM Ahead: Merging Science and Communications to Investigate Environmental Questions G.K. Bidmeier-Prayer, Jacksonville University / Chemistry; A. Kent-Willette, Jacksonville University / Communications; M. Simmons, Jacksonville University / Biology and marine sciences

This project involved a case study and best practices surrounding successful STEAM interdisciplinary research. The collaboration was fostered through events at benefit studies. The results involved a two year research agenda. The study focused on graduate and undergraduate interdisciplinary research in the fields of Environmental Science and Communications. Specifically, the influence of changing land use along the lower St. Johns River, Fl. was investigated, and the project and resulting data were published using modern communication tools such as social media, in tandem with more typical scientific means such as presentations at the annual SETAC meetings. The focus of the collaborative research was the development of an online open access book on Environmental Toxicology that should cover the field in its full width, including aspects of environmental chemistry, ecotoxicology, toxicology and risk assessment. The initiative is sponsored by the Netherlands Ministry of Education. The project aims at developing an open online book environmental toxicology that is useful for training at BSc, MSc and higher levels. The book will be designed in a modular way, each module having a clear training goal/attainment level and flagged with a number of keywords. The book will also contain tools for self-study and training, like exercises and questions. With the book, we aim at improving quality, continuity and transparency of the education in environmental toxicology. We also want to make sure that fundamental insights on fate and effects of chemicals gained in the past are combined with recent approaches of effect assessment and molecular analysis of mechanisms causing toxicity. To guarantee quality of the book and associated training materials, we aim at having 1-2 authors for each module and also 1-2 reviewers from outside the team of authors. In addition, an advisory board will be involved in supervising the project, as well as educational advisors, while the project team will serve as an editorial board. The project team, consisting of 61 environmental toxicologists and chemists from six Dutch universities, does not possess all expertise to cover the width of the field. We therefore solicit contributions from as many colleagues as possible from within the SETAC community. With that, we hope we can produce a book that is written and supported by SETAC, that is covering the entire field, and is useful for training within e.g. the SETAC Europe Certified Risk Assessor (CRA) programme. The publication as an open online book will allow continuous updating of the book, providing a possible role of SETAC in sustaining the book.

WEPC15 Policy learning through professional forums in the field of environmental toxicology: What role for the Society of Environmental Toxicology and Chemistry (SETAC)? M. Monduzzi, McGill University - Macdonald Campus / Department of Natural Resources Science; G. Hickey, McGill University - Macdonald Campus / Natural Resources Sciences; S. Maguire, McGill University; D. Crump, Environment and Climate Change Canada / National Wildlife Research Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology; N. Basu, McGill University / Faculty of Agricultural and Envi
vitro cell- or genomics-based testing strategies (Waters and Fostel 2004). For more than a decade, these alternatives have been discussed and debated in a range of high profile forums (National Research Council 2007) as offering potential answers to the various challenges facing chemical risk assessment. However, the accepted regulatory approaches to determining the risk of chemicals in environmental toxicology have remained, for the most part, unaffected. This poster explores the role of SETAC in policy learning using primary survey data collected from participants in previous SETAC forums. We will summarize the instrumental paradigm and core policy beliefs concerning alternative testing methods of responders and assess their self-reported policy learning experiences at SETAC. We will then consider the significance of SETAC as a professional forum through which policy actors learn and adapt to emerging challenges in regulatory science.

WEPC16
SETAC Science and Risk Communication Interest Group
T. Seiler, RWTH Aachen University / Ecosystem Analysis

Thinking green and circularly about microparticles, nanomaterials and composite materials: approaches for recovery, recycling and reuse (PC)

WEPC17
Biochar-mortar composites for construction materials
S. Oht, T. Sen, University of Ulsan / Department of Civil and Environmental Engineering; Y. Soo, University of Ulsan / Civil and Environmental Engineering

Feasibility of biochar for construction material was examined through synthesis of biochar-mortar composites and evaluation of their construction and environmental properties according to mixing ratios. Characterization of biochar-mortar composites showed that 3-5% biochar inclusion did not significantly change their flowability, compressive strength, and thermal conductivity. As biochar content increased in biochar-mortar composites, benzene concentration in air was accordingly reduced, suggesting that biochar may be favorable to remove toxic contaminants causing sick building syndrome. Toxicity characteristics leaching procedure (TCLP) and Micotox® bioassay tests showed that biochar-mortar composite were not toxic. Our results suggest that biochar-mortar composites may be promising environmental-friendly materials for building and infrastructure construction area.

WEPC18
Complex Formation Trends of Ligand Binding toward In(III) and Ge(IV)
D. Wondrouusch, G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

In recent years, the demand for strategic elements such as Indium and Germanium has increased due to strong global economic growth, especially in the realm of semiconductors. Dwindling resources and growing demand necessitate new recycling strategies and the reassessment of existing repositories in the light of newly developed technologies. In this context, QSAR methods can be utilized in the development of chelating agents designed for affinity toward strategic elements. Through this, novel ligand concepts can be rapidly assessed and synthesis can be prioritized toward promising ligands, resulting in a shortened development cycle and reduced research costs. In our quantum chemical study, we analyze a systematic set of chelators with respect to their complex formation energies toward selected InⅢ and GeⅣ complexes. Following a first principles approach, Density Functional Theory and higher levels of theory have been used for the calculations, also addressing bulk solvation effects. The study focuses on both affinity and selectivity. General trends in binding affinity to selected ions are discussed as related to the electronic structure of the compounds. Chelator selectivity toward InⅢ and GeⅣ is investigated in comparison to FeⅢ, FeⅣ, CuⅡ and ZnⅡ. The importance of both properties arises from expected high concentrations of interfering ions relative to the strategic elements of interest. Financial support from the Krüger Research School “Biodynamometricallurgical Center for Strategic Elements” BHMZ (Nr. 0210205) is gratefully acknowledged.

WEPC19
Cellulose Nanofibers as building blocks for innovative materials for remediation
A. Fioratti, INSTM local unit @ Politecnico di Milano / Department of Chemistry, Materials and Chemical Engineering G. Natta and INSTM Local Unit; A. Graziano, L. Melone, Politecnico di Milano / Department of Chemistry, Materials and Chemical Engineering G. Natta; I. Corsi, University of Siena / Physical, Earth and Environmental Sciences; G. Grassi, University of Siena / Department of Physical, Earth and Environmental Sciences; N.Pastori, Politecnico di Milano / Department of Chemistry, Materials and Chemical Engineering G. Natta; C. Punta, Politecnico di Milano

From the point of view of circular economy cellulose is one of the most interesting biopolymer since it derives from renewable sources which, thanks to its peculiar structural properties, it is widely used in the design of simple and advanced materials for different applications. Recently, cellulose nanofibers (CNF) were proven to be versatile building blocks for many preparations. The regioselective oxidation of the C6 primary hydroxyls of the anhydroglucose units, catalysed by TEMPO in the presence of the NaBr/NaClO oxidant system, leads to the formation of TEMPO-oxidized CNF (TOCNF), conferring to the cellulose many interesting properties.1,2 We recently report the synthesis of sponge-like nano-structured materials by cross-linking TOCNF and branched polyethyleneimine (bPEI).3 These nano-structured materials were fully characterized from a chemical, structural and mechanical point of view. Quantitative information on their inner microstructure were collected by Micro-Computed Tomography (μ-CT) analysis.4 In addition the material can be easily modified in order to introduce additional chemical or structural properties. As an example, by functionalizing the bPEI with pNO2-phenyl-urea units it is possible to obtain a material that can be employed for the heterogeneous and selective sensing of fluoro anions. Furthermore, the addition of citric acid (CA) as co-crosslinker enforce the mechanical and structural performances.5 Another application of bPEI-TOCNF sponges is the controlled release of active principles. They have been used it for adsorption and release of two model drugs, amoxicillin and ibuprofen. The material showed very good performances in adsorbing both model drugs (~200 mg g−1) from methanol solution. Interestingly, the presence of CA lead to slower kinetic release in aqueous environments if compared with materials obtained without CA.6 The ongoing NanoBonD project is focused on the use of these sponge-like materials for soil and water remediation. We have demonstrated that these materials exhibit superb performances in removing contaminants both from fresh and from sea water. In particular we are able to remove heavy metals (ZnⅡ, CdⅡ, PbⅡ, CrⅢ and CuⅡ) and organic contaminants (e.g. pyriacetan/cyanoacetate).8 This is knowing regulating the effects in obtained organisms (Avelelas et al. 2017; Martins et al. 2017). Martins et al. (2017) showed no acute effects on marine clams (till 100 mg/L), but significant biochemical effects, even at low exposure concentrations. The present study aimed to assess the hazard of Zn-Al LDH in several marine species representing different trophic levels. Exposure tests were carried out with 15 species, including bacterium (Vibrio fischeri), cyanobacterium (Arthrospira maxima), microalgae (Chlorella vulgaris, Nanochloropsis gaditana, Phaeodactylum tricornutum, Tetraselmis chuii and Thalassiosira pseudonana), rotifer (Brachionus plicatilis), bivalves (Cerastoderma edule and Mytilus galloprovincialis), polychaete (Heliste diversicolor), crustaceans (Acartia tonsa, Artemia salina and Palaeon varians) and sea urchin embryos (Paracentrotus lividus). Acute and short-term chronic exposure tests followed standard or well described guidelines, with appropriate adaptions in some cases. Exposure concentrations ranged between 0.01 and 100 mg/L depending on the species tested. The nanomaterial exhibited no toxic effects in most of the tested species, even at the highest exposure concentration. However, adverse sub-lethal effects, such as changes in the enzymatic activity or the physiological endpoints were detected in bivalves and cyanobacteria. Water processed waters have also been evaluated by μ-CT analysis.

WEPC20
Zn-Al layered double hydroxides: a promising eco-friendly engineered nanomaterial
R. Martins, Department of Biology, University of Aveiro / Department of Biology and CESAM; J. Figueiredo, University of Aveiro / Biology; A.M. Soares, University of Aveiro / department of Biology & CESAM; J. Tedim, University of Aveiro / Department of Materials and Ceramic Engineering CICECO; S. Loureiro, Universidade de Aveiro / Biology

Layered double hydroxides (LDH), also known as anionic nanoclays, are a class of inorganic engineered nanomaterials with a plate-like structure featuring a lateral size of 20–40 nm. LDH are characterized by positively charged metal hydroxides (e.g. ZnⅡ, AlⅢ), stabilized by anions (e.g. NO3-) and water molecules between layers. LDH have remarkable physicochemical properties, non-toxic nature, high specific surface area and stability. The safe-by-design structure and composition as well as the properties of Zn-Al LDH have led their use in several industrial and material engineering greener applications, as well as in medicine and pharmaceutics for a safe controlled release of drugs. Despite LDH have been regarded as having low toxicity, little is known regarding the effects in obtained organisms (Avelelas et al. 2017; Martins et al. 2017). Martins et al. (2017) showed no acute effects on marine clams (till 100 mg/L), but significant biochemical effects, even at low exposure concentrations. The present study aimed to assess the hazard of Zn-Al LDH in several marine species representing different trophic levels. Exposure tests were carried out with 15 species, including bacterium (Vibrio fischeri), cyanobacterium (Arthrospira maxima), microalgae (Chlorella vulgaris, Nanochloropsis gaditana, Phaeodactylum tricornutum, Tetraselmis chuii and Thalassiosira pseudonana), rotifer (Brachionus plicatilis), bivalves (Cerastoderma edule and Mytilus galloprovincialis), polychaete (Heliste diversicolor), crustaceans (Acartia tonsa, Artemia salina and Palaeon varians) and sea urchin embryos (Paracentrotus lividus). Acute and short-term chronic exposure tests followed standard or well described guidelines, with appropriate adaptions in some cases. Exposure concentrations ranged between 0.01 and 100 mg/L depending on the species tested. The nanomaterial exhibited no toxic effects in most of the tested species, even at the highest exposure concentration. However, adverse sub-lethal effects, such as changes in the enzymatic activity or the physiological endpoints were detected in bivalves and cyanobacteria. Water processed waters have also been evaluated by μ-CT analysis.
volume of the microfibers released. In the current study, we assess the release of microfibers from different fleece fabrics with the aim of identifying production methods and fabric properties that release the fewest microfibres during domestic washing machines. A filter unit consisting of a 300 µm filter and a 100 µm filter in series was connected to the effluent pipe of a domestic washing machine. Each fleece test fabric (140 cm x 90 cm) was prepared by overlapping the edges to prevent loss of fabric from the filter unit. A standard synthetic clothing program was used (60°C, 40°C). Correct weights of the washing machines were mass for each material assessed and a consistent water flow into the machine. Effluent water was collected in a clean container and a sub-sample (1 L) passed through a 20 µm filter to collect any microfibres that pass through the filter unit. Each test fabric was first washed to study release in new clothes, and then washed a second time to determine release after clothing washing and shedding. To improve the accuracy of the results, the two washing procedures were repeated in triplicate. A rinse cycle was run between each test wash to ensure removal of any remaining microfibres from the system. The hoses connecting the filters contained residual microfibres after washing; these were collected after each wash by cleaning the hoses manually. The pre-weighted filters were allowed to dry before the mass of fibres was determined. The number of fibres was then estimated based on microscopy counting of a pre-weighed sub-sample of the microfibres. Preliminary results show that ~80–90% of fibres in the effluent water are trapped by the 300 µm filter. Furthermore, the fibre release declines with successive washings. A detailed study of the underlying mechanisms is currently ongoing and the results will be used as a basis for ranking.

WEP2C2 Exploring a Potential Nano-fertilizer: Effects of Silica Nanoparticles on Alfalfa (Medicago sativa) F. Schwab, Adolphe Merkle Institute / Materials Science; M. Macheroni, Adolphe Merkle Institute / BioNanoMaterials; A. Petri-Fink, B. Rothen-Rutishauser, Adolphe Merkle Institute / BioNanomaterials Group; Nano-agrochemicals promise higher efficiency than conventional pesticides, but much has to be learned about the gain of efficiency compared to conventional products, and the risk of directly applying such new types of yield enhancers on agricultural soil. Due to the relatively low acute toxicity and high natural abundance of silica nanoparticles (SiO$_2$-NPs), they are highly attractive for benign-by-design strategies in agriculture. Here, we present initial results of experiments that are in the process of being conducted on a laboratory scale to compare the effects of SiO$_2$-NPs and conventional fertilizer and pesticide ingredients, and combinations thereof, on the agricultural legume alfalfa (lucerene, Medicago sativa). The SiO$_2$-NPs used for the experiments were ~60 nm in primary particle diameter. As reference substance for conventional pesticides, the broadband fungicide tebuconazole was tested. Seed germination and infection tests, and a plant growth test were conducted. The Si was quantified by inductively coupled plasma optical emission spectroscopy (ICP-OES). Beneficial effects of SiO$_2$-NPs were found for the fungal infection and germination rates in alfalfa, while the growth rates in the seedlings transferred to and grown in soil remained largely unaffected. The results confirm the moderate protective effects of silica nanoparticles on plants that have been reported previously, likely linked to the release of orthosilicic acid (Si(OH)$_4$) acting as a phytostimulant micromutant. The use of silica in nanoagrochemicals promises to reduce the organic pesticide burden of agricultural soil and crops. Acknowledgement: The authors thank the Swiss National Science Foundation (http://p3.snf.ch/Project-168187) and the Adolphe Merkle Foundation for the support and funding of the study. We thank Laura Rodriguez-Lorenzo, Dimitri Vanhecke, and Sandor Balog for helpful discussions regarding ICP-OES analytics, electron microscopy, and dynamic light scattering, respectively.

LCA and beyond • integrating sustainability and/or other dimensions to improve decision support (PC)

WEP2C3 Environmental Footprint for pasta production - the PEF pasta pilot L. Ruini, Barilla G.E.R. Fratelli Societa per Azioni; L. Laurena, UN-A.F.P.A.; L. Marchelli, Barilla G. & R. Fratelli; P. Borla, Life Cycle Engineering UN-A.F.P.A. representing all the European pasta manufacturers, is the main protagonist of the EU pilots on PEF for pasta production. Furthermore, seven Italian companies of pasta producers (Barilla, Pasta Zara and Garofalo) decided to be directly part of the Technical Secretariat. The proponents of the pilot for pasta together represent about the 30% of the total production of pasta in the European Union. The PEF pilot, while encouraging the development of sustainable production all over the supply chain from farm to fork, enhances fair competition among pasta and pasta products, and it is designed with the aim to set up and validate the developments process of product group-specific rules (PEFCR), including the development of performance benchmarks; Testing different compliance and verification systems, to set up and validate proportionate, effective and efficient compliance and verification systems; Testing different business-to-business and business-to-consumer PEF information systems in collaboration with stakeholders. The secretariat sees the PEF pilot as a big opportunity for the pasta sector since there are some pasta producers that already measure and communicate the environmental impacts through voluntary certification schemes. A methodology promoted by the European Commission can encourage other producers to communicate the environmental footprint of their pasta, making PEF a tool to increase competitiveness with important benefits for sustainable agriculture and food production. This approach would be also for consumers. Giving people reliable and comparable information about the environmental impacts and creating new product and organizational strategies might allow the most resource efficient and environmentally-friendly products. During the PEF pilot, an average impact value, representative of the category of dried pasta has been obtained to allow the environmental performance comparison among different products in the same category. This benchmark impact highlighted the process hotspots as cereals cultivation, pasta production and cooking phase. All addressed rules and hypotheses in the PEFCR document have been established, but the maximum clarity in order to increase the suitability and robustness of the LCA implemented in the PEF method for pasta sector. The main difficulties noticed during the pasta pilot were about the hotspots management, when the producers do not directly manage those processes.

WEP2C5 Life Cycle Assessment of applying Algal Oil in salmon aquaculture: challenges for methodology and tool development H. Bosch, DSM Nutritional Products; A. Wojciechowski, Evonik Technology & Infrastructure; M. Binder, Evonik Nutrition & Care GmbH; F. Ziegler, RISE Research Institutes of Sweden. Evolving DSM found the joint venture Veramaris®, introducing a new Algal Oil based omega-3 fatty acid source for aquaculture. This intracellular oil is produced in a biotechnological manufacturing process using non-marine resources. The rationale for this development is that the capacity to generate omega-3 fatty acids through fish is not sufficient to fulfill the dietary requirements of a growing population, and that many fish species used as feed in aquaculture are either fully utilized or overfished, leaving little room for expansion. Algal Oil reduces the dependency of salmon aquaculture on marine fatty acid production and fish stocks, by replacing marine ingredients with algal oil and crop-based ingredients. To illustrate the environmental impacts and potential tradeoffs of this new product, a Life Cycle Assessment (LCA) was performed. Indicators developed for application of LCA to fisheries were used in an LCA to assess the marine ecosystem impact of replacing fish meal and fish oil by Algal Oil in salmon feed. The analysis had to be performed in a separate calculation outside the LCA software, because the software does not include the required data and methods. The study demonstrated that the use of Algal Oil as a source of omega-3 fatty acids leads to a considerable reduction of impact on marine ecosystems of farmed salmon. This improvement is accompanied by an increase in impacts associated with agriculture. Current LCA methodologies do not allow weighting of these opposing effects. However, to make informed choices between the available options this would be required. Because the availability of natural marine resources is limited, the strong growth expected in salmon aquaculture requires innovative feed solutions decoupled from limited fish stocks to meet future requirements for omega-3 fatty acids. Veramaris® Algal Oil in combination with vegetable crops enables growth of salmon aquaculture that is independent of limited fish stocks. To support the choices discussed in this presentation, and similar choices, implementation of fishery impact assessment methods in LCA tools and development of weighting methodology is essential. Just as for other biotic impacts, there are also challenges of non-linearity and temporal and spatial variability connected to fishery-specific impacts, which are of a more local nature than global-scale life cycle impacts.

WEP2C6 Balancing Environmental and Health Impacts of Food Production and Consumption C. Walker, Institute of Environmental Engineering, ETH Zurich; S. Hellweg, ETH Zurich / Institute of Environmental Engineering An individual’s food choices can affect not only the magnitude of their food related environmental footprint, but can also have a direct effect on their personal health. People consuming lower amounts of meat tend to have lower environmental impacts, but it has also been found that they also tend to have lower risk of certain diseases. On the other hand, people with low vegetable or fruit consumption may also have relatively lower environmental impacts, while having increased risk of disease. This study investigates the daily eating patterns of a European population sample to identify and compare each individual’s environmental impacts due to their food production as well as the health impacts that can be expected due to their food consumption patterns. The Global Burden of Disease has identified dietary risk factors that have been proven to contribute to increased disease risk such as low fruit, vegetable, nut and seed, or omega-3 intake and high red meat or processed meat intake. The relationship between the environmental impacts from producing foods classified in the dietary risk factor categories are compared to the health impacts associated with consuming these foods. From this investigation, we can estimate the magnitude of the health benefits associated with additional food production, as is shown in an example of whole grain consumption. Results show that for individuals under-consuming whole grains (less than 125 grams daily), for every 1 micro disability adjusted life year (µDALY) increase in production impacts, there is a health benefit of 141 µDALYs. Similar results were found for all
dietary risk categories in which under-consumption of a particular food group was considered a dietary risk. In cases where overconsumption poses a health risk, as is the case in certain meats, sodium, and sugar sweetened beverages, a 1 µDALY increase in production impacts is associated with increases in health impacts to varying degrees, ranging from 1.2 µDALYs for red meat up to 36.8 µDALYs for sugar sweetened beverages. This study found that for most of the dietary risk categories, health impacts due to consumption far outweighed the environmental impacts (measured in terms of µDALYs), however this study did not include environmental impacts as they are related to other impact categories such as ecosystem damage and resource depletion, which must also be considered to fully capture food production impacts.

**WEPC27**

What not to waste? Improving decision support for Food Loss and Waste (FLW) mitigation by considering food security and environmental sustainability

F. Sessa, Quantis; M. Ruth, World Business Council for Sustainably Development (WBCSD); D. Pollard, Nestlé; K. Cooper, A. Cairns, World Business Council for Sustainably Development (WBCSD); X. Bengoa, S. Humbert, M. Vargas Gonzalez, A. Ernstoff, Quantis

LCA-based methods provide evidence of the largescale environmental impacts of food production. Nearly a third of food produced is lost or wasted, meaning production impacts occur with little to no societal service. The primary focus of response e.g. the UN SDG 12.3 has been on avoiding food loss and waste (FLW) quantities, for example halving food waste by 2030. Decision-makers, thus may prioritize FLW mitigation based on quantity, economical gain, and ease of implementation. To support multi-criteria sustainability decision-making we develop a framework and perform a global screening to prioritise FLW mitigation efforts based on two material issues: environmental impacts and nutrition security. LCA-based methods quantify environmental impacts related to FLW streams, and nutrition and global burden of disease data are used to quantify nutrition security. A global screening of FAO data on food production, supply, and FLW for various food categories (e.g. grains) is performed in 15 countries. Results demonstrate vastly different environmental impacts and nutrition security potential associated with various FLW streams. The results suggest that there is sufficient production of most nutrients globally, suggesting that in most cases food systems do not need to grow, but need to be optimized to reduce FLW and offer appropriate regional supply.

**WEPC28**

ARIADNA Project. Analysing the sustainability of implementing a mandatory Deposit-Refund System in Spain

A. Bala, UNESCO Chair in Life Cycle and Climate Change (ESCI-UPF); UNESCO Chair in Life Cycle and Climate Change. Escola Superior de Comerç Internacional ESCI; P. Fulliana, B. Díaz, Universitat Pompeu Fabra UPF / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI; R. Colomé, Universitat Pompeu Fabra UPF / Escola Superior de Comerç Internacional; J. Ribas, Universitat Pompeu Fabra UPF; S. Ayuso, Universitat Pompeu Fabra UPF / MANGO Chair in Corporate Social Responsibility; I. Muñoz, O. LCA consultants; B.P. Weidema, Aalborg University / Department of Planning

There is currently an ongoing debate in some Spanish regions on whether the implementation of a mandatory deposit-refund system (DRS hereafter) would be appropriate. A DRS can be simply defined as a system in which consumers pay a certain amount in concept of “packaging deposit” added to the price of a product and receive the refund back when they return the used packaging. This is a system in place in some European Countries such as Germany, Finland or Denmark whereas others such as France or the UK have refused its implementation. From a regulatory point of view, the Spanish Law 22/2011 (which transposes the correspondent European Directive 2008/98/CE), clearly states that the implementation of a DRS should be based on the analysis of its technical and economic feasibility, a set of environmental, social and human health impacts and must ensure the proper functioning of the internal market. The study presented here follows this regulatory framework, analysing the sustainability of implementing this new system, combining environmental, economic and social studies in order to get an holistic picture of its feasibility. In particular, the following methodologies were used: (1) Life Cycle Assessment (LCA) for the environmental study; (2) Classic Cost Accounting for the economic study and (3) Social Footprint and Quantification of the Integrated Social Value for the social study. All of them applied using the same data, system boundaries and modelling restrictions. The study clearly concludes that the introduction of a DRS in Spain, under the studied conditions, is not advisable. This is because: a) according to several environmental indicators, although it could achieve an improvement in the overall recycling rate, it carries a higher environmental impact, mainly due to the duplication of collecting systems and the increase demand in transportation; b) represents a 4.6-fold increase in the economic cost to society (11 times if we only consider the management of DRS containers); and c) from a stakeholders’ point of view, it will have a significant increase both in space and time needs, and it will cause a higher Social Footprint.
Risk assessment.

Toxicokinetics.

Spatial.

Sediment.

Soil.

The following is a list of statistical skills and methods:
- Data collection
- Data cleaning
- Descriptive statistics
- Inferential statistics
- Regression analysis
- Clustering
- Dimensionality reduction
- Time series analysis
- Spatial analysis
- Network analysis

3.3.1.1. Toxicokinetics

3.3.1.2. Sediment

3.3.1.3. Soil

3.3.1.4. Spatial

3.3.1.5. Toxicokinetics
The Society of Environmental Toxicology and Chemistry (SETAC) is a not-for-profit, global professional organisation comprised of some 6000 individual members and institutions dedicated to the study, analysis and solution of environmental problems, the management and regulation of natural resources, research and development, and environmental education. SETAC Europe is one of the five Geographic Units of the global Society, established to promote and undertake activities of SETAC in Europe, and to support activities of SETAC in the Middle East and Africa. The Society is dedicated to the use of multidisciplinary approaches to examine the impacts of stressors, chemicals and technology on the environment. We also provide an open forum for scientists and institutions engaged in the study of environmental problems, management and regulation of natural resources, education, research and development, and manufacturing. SETAC Europe is incorporated in Belgium as a not-for-profit organisation. The Society is governed according to its articles of association and by-laws. SETAC Europe maintains its administrative office in Brussels, Belgium.